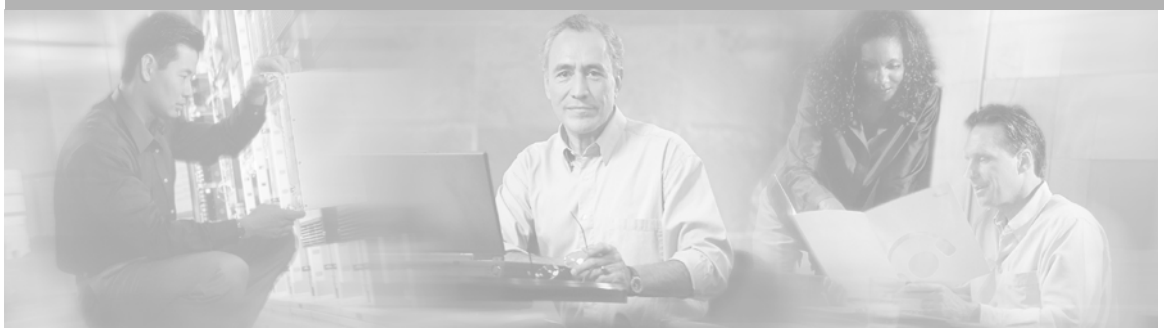

Cisco ONS 15454 SDH Reference Manual

Product and Documentation Release 7.0
Last Updated: October 2008

Corporate Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
http://www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 526-4100

Text Part Number: 78-17195-01

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About this Manual

Note The terms "Unidirectional Path Switched Ring" and "UPSR" may appear in Cisco literature. These terms do not refer to using Cisco ONS 15xxx products in a unidirectional path switched ring configuration. Rather, these terms, as well as "Path Protected Mesh Network" and "PPMN," refer generally to Cisco's path protection feature, which may be used in any topological network configuration. Cisco does not recommend using its path protection feature in any particular topological network configuration.

This section explains the objectives, intended audience, and organization of this publication and describes the conventions that convey instructions and other information.

This section provides the following information:

- Revision History
- Document Objectives
- Audience
- Document Organization
- Related Documentation
- Document Conventions
- Obtaining Optical Networking Information
- Obtaining Documentation and Submitting a Service Request

Revision History

Date	Notes
March 2007	Revision History Table added for the first time.
April 2007	Corrected product part numbers for the UBIC-V and UBIC-H DS3 cables. Added note to indicate the support for LO circuits in SNCP in XC-VXC-10G card.
August 2007	Updated the note in the SNCP Circuits section of the Circuits and Tunnels chapter. Updated About this Manual chapter.
October 2007	Added a table with border error rates and a corresponding Note in the Performance Monitoring chapter.

Date	Notes
April 2008	Added a note in the "User Password, Login, and Access Policies" section in the Security chapter. Updated note on protection switching in "Link Capacity Adjustment" section of Chapter 11, Circuits and Tunnels.
May 2008	Added power-level LED information for TCC2 and TCC2P cards in Chapter 2, Common Control Cards.
July 2008	Updated the section "15454_MRC-12 Port-Level Indicators" in the Optical Cards chapter, to show the correct number and status of the Rx indicator. Added a note in section 10.1 "Timing Parameters" section of Chapter 10, Timing.
September 2008	Added a Warning for all optical cards in Chapter 4, Optical Cards. Added a note in Card Default Settings and Node Default Settings section of Appendix C, Network Element Defaults. Updated the maximum current rating and fusing in section "A.1.9 System Power" of Appendix A, Hardware Specifications. Updated FC_MR-4 Statistics Parameters table in the chapter, Performance Monitoring. Updated "Table 4-17 Line Rate Configurations Per 15454_MRC-12 Port, Based on Available Bandwidth" in Chapter 4, Optical Cards. Updated the Software and Hardware Compatibility section.
October 2008	Updated the section "4.15.2 Ports and Line Rates" and "Table 4-17 Line Rate Configurations Per 15454_MRC-12 Port, Based on Available Bandwidth" in Chapter 4, Optical Cards.

Document Objectives

This manual provides reference information for the Cisco ONS 15454 SDH.

Audience

To use this publication, you should be familiar with Cisco or equivalent optical transmission hardware and cabling, telecommunications hardware and cabling, electronic circuitry and wiring practices, and preferably have experience as a telecommunications technician.

Document Organization

Table 1 lists the chapter titles and provides a summary for each chapter.

Table 1 Cisco ONS 15454 SDH Reference Manual Chapters

Title	Summary
Chapter 1, “Shelf and FMEC Hardware”	Includes descriptions of the rack, ferrites, power and ground, fan-tray assembly, air filter, card slots, cable, cable connectors, and cable routing.
Chapter 2, “Common Control Cards”	Includes descriptions of the TCC2P, XC10G, XC-VXL, and AIC-I cards.
Chapter 3, “Electrical Cards”	Includes descriptions of E1-N-14, E1-42, E3-12, DS3i-N-12, STM1E-12, FMEC cards, MIC cards, card temperature ranges, and compatibility.
Chapter 4, “Optical Cards”	Includes descriptions of the STM1-4, STM1-8, STM-4, STM4-4, STM-16, STM-64, TXP_MR, TXPP_MR, and MXP cards, as well as card temperature ranges and card compatibility.
Chapter 5, “Ethernet Cards”	Includes descriptions of the E100T-G, E1000-2-G, G1000-4, G1K-4, CE-100T-8, ML100T-12, ML1000-2, and ML100X-8 cards, gigabit interface converters (GBICs) and small form-factor pluggables (SFPs).
Chapter 6, “Storage Access Networking Cards”	Includes the FC_MR-4 card description and application.
Chapter 7, “Card Protection”	Includes electrical, optical, and transponder and muxponder card protection methods, as well as external switching commands.
Chapter 8, “Cisco Transport Controller Operation”	Includes information about CTC delivery, installation, computer requirements, connection, the CTC window, and database reset and revert.
Chapter 9, “Security”	Includes user set up, security parameters and profiles, audit trail information, and RADIUS authentication information.
Chapter 10, “Timing”	Includes node and network timing information.
Chapter 11, “Circuits and Tunnels”	Includes descriptions of circuit properties, cross-connect card bandwidth usage, data communications channel (DCC) and IP-encapsulated tunnels, multiple destination circuits, circuit monitoring, subnetwork connection protection (SNCP) and multiplex section-shared protection rings (MS-SPRing) circuits, J1 path trace, path signal labels, manual and automatic circuit routing, and virtual concatenated (VCAT) circuits.
Chapter 12, “SDH Topologies and Upgrades”	Includes the SDH configurations used by the ONS 15454 SDH; including MS-SPRings, SNCPs, subtending rings, linear ADMs, and optical bus configurations, as well as information about upgrading optical speeds within any configuration.

Table 1 Cisco ONS 15454 SDH Reference Manual Chapters (continued)

Title	Summary
Chapter 13, "Management Network Connectivity"	Provides an overview of ONS 15454 SDH data communications network (DCN) connectivity, scenarios showing Cisco ONS 15454 SDH nodes in common IP network configurations, and information about provisionable patchcords, the IP routing table, external firewalls, and open gateway network element (GNE) networks.
Chapter 14, "Alarm Monitoring and Management"	Explains alarm, condition, and history display; severities; profiles; suppression; external alarms; and the audit trail.
Chapter 15, "Performance Monitoring"	Provides performance-monitoring parameters for all ONS 15454 SDH cards.
Chapter 16, "SNMP"	Describes simple network management protocol (SNMP) as it applies to the ONS 15454 SDH.
Appendix A, "Hardware Specifications"	Provides specifications for the ONS 15454 SDH shelf assembly and cards.
Appendix B, "Administrative and Service States"	Describes the extended state model for cards, ports, and cross-connects.
Appendix C, "Network Element Defaults"	Lists card, node, and CTC-level network element (NE) defaults.

Related Documentation

Use the *Cisco ONS 15454 SDH Reference Manual* with the following referenced publications:

- *Cisco ONS 15454 SDH Procedure Guide*
  Provides procedures to install, turn up, provision, and maintain a Cisco ONS 15454 SDH node and network.
- *Cisco ONS 15454 SDH Troubleshooting Guide*
  Provides general troubleshooting procedures, alarm descriptions and troubleshooting procedures, error messages, and transient conditions.
- *Cisco ONS 15454 SDH TL1 Command Guide*
  Provides a full TL1 command and autonomous message set including parameters, AIDs, conditions and modifiers for the Cisco ONS 15454 SDH.
- *Cisco ONS 15454 SDH TL1 Reference Guide*
  Provides general information, procedures, and errors for TL1 in the Cisco ONS 15454 SDH.
- *Ethernet Card Software Feature and Configuration G uide for the Cisco ONS 15454, Cisco ONS 15454 SDH, and Cisco ONS 15327*
  Provides software features for all Ethernet cards and configuration information for Cisco IOS on ML-Series cards.
- *Release Notes for the Cisco ONS 15454 SDH Release 7.0*
  Provides caveats, closed issues, and new feature and functionality information.

For an update on End-of-Life and End-of-Sale notices, refer to http://cisco.com/en/US/products/hw/optical/ps2006/prod_eol_notices_list.html.

Document Conventions

This publication uses the following conventions:

Convention	Application
boldface	Commands and keywords in body text.
italic	Command input that is supplied by the user.
[ ]	Keywords or arguments that appear within square brackets are optional.
{ x | x | x }	A choice of keywords (represented by x) appears in braces separated by vertical bars. The user must select one.
Ctrl	The control key. For example, where Ctrl + D is written, hold down the Control key while pressing the D key.
`screen font`	Examples of information displayed on the screen.
`boldface screen font`	Examples of information that the user must enter.
< >	Command parameters that must be replaced by module-specific codes.

Note Means *reader take note*. Notes contain helpful suggestions or references to material not covered in the document.

Caution Means *reader be careful*. In this situation, the user might do something that could result in equipment damage or loss of data.

Warning **IMPORTANT SAFETY INSTRUCTIONS**

This warning symbol means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. Use the statement number provided at the end of each warning to locate its translation in the translated safety warnings that accompanied this device. Statement 1071

SAVE THESE INSTRUCTIONS

Waarschuwing **BELANGRIJKE VEILIGHEIDSINSTRUCTIES**

Dit waarschuwingssymbool betekent gevaar. U verkeert in een situatie die lichamelijk letsel kan veroorzaken. Voordat u aan enige apparatuur gaat werken, dient u zich bewust te zijn van de bij elektrische schakelingen betrokken risico's en dient u op de hoogte te zijn van de standaard praktijken om ongelukken te voorkomen. Gebruik het nummer van de verklaring onderaan de waarschuwing als u een vertaling van de waarschuwing die bij het apparaat wordt geleverd, wilt raadplegen.

BEWAAR DEZE INSTRUCTIES

Varoitus **TÄRKEITÄ TURVALLISUUSOHJEITA**

Tämä varoitusmerkki merkitsee vaaraa. Tilanne voi aiheuttaa ruumiillisia vammoja. Ennen kuin käsittelet laitteistoa, huomioi sähköpiirien käsittelemiseen liittyvät riskit ja tutustu onnettomuuksien yleisiin ehkäisytapoihin. Turvallisuusvaroitusten käännökset löytyvät laitteen mukana toimitettujen käännettyjen turvallisuusvaroitusten joukosta varoitusten lopussa näkyvien lausuntonumeroiden avulla.

SÄILYTÄ NÄMÄ OHJEET

Attention **IMPORTANTES INFORMATIONS DE SÉCURITÉ**

Ce symbole d'avertissement indique un danger. Vous vous trouvez dans une situation pouvant entraîner des blessures ou des dommages corporels. Avant de travailler sur un équipement, soyez conscient des dangers liés aux circuits électriques et familiarisez-vous avec les procédures couramment utilisées pour éviter les accidents. Pour prendre connaissance des traductions des avertissements figurant dans les consignes de sécurité traduites qui accompagnent cet appareil, référez-vous au numéro de l'instruction situé à la fin de chaque avertissement.

CONSERVEZ CES INFORMATIONS

Warnung **WICHTIGE SICHERHEITSHINWEISE**

Dieses Warnsymbol bedeutet Gefahr. Sie befinden sich in einer Situation, die zu Verletzungen führen kann. Machen Sie sich vor der Arbeit mit Geräten mit den Gefahren elektrischer Schaltungen und den üblichen Verfahren zur Vorbeugung vor Unfällen vertraut. Suchen Sie mit der am Ende jeder Warnung angegebenen Anweisungsnummer nach der jeweiligen Übersetzung in den übersetzten Sicherheitshinweisen, die zusammen mit diesem Gerät ausgeliefert wurden.

BEWAHREN SIE DIESE HINWEISE GUT AUF.

Avvertenza **IMPORTANTI ISTRUZIONI SULLA SICUREZZA**

Questo simbolo di avvertenza indica un pericolo. La situazione potrebbe causare infortuni alle persone. Prima di intervenire su qualsiasi apparecchiatura, occorre essere al corrente dei pericoli relativi ai circuiti elettrici e conoscere le procedure standard per la prevenzione di incidenti. Utilizzare il numero di istruzione presente alla fine di ciascuna avvertenza per individuare le traduzioni delle avvertenze riportate in questo documento.

CONSERVARE QUESTE ISTRUZIONI

Advarsel **VIKTIGE SIKKERHETSINSTRUKSJONER**

Dette advarselssymbolet betyr fare. Du er i en situasjon som kan føre til skade på person. Før du begynner å arbeide med noe av utstyret, må du være oppmerksom på farene forbundet med elektriske kretser, og kjenne til standardprosedyrer for å forhindre ulykker. Bruk nummeret i slutten av hver advarsel for å finne oversettelsen i de oversatte sikkerhetsadvarslene som fulgte med denne enheten.

TA VARE PÅ DISSE INSTRUKSJONENE

Aviso **INSTRUÇÕES IMPORTANTES DE SEGURANÇA**

Este símbolo de aviso significa perigo. Você está em uma situação que poderá ser causadora de lesões corporais. Antes de iniciar a utilização de qualquer equipamento, tenha conhecimento dos perigos envolvidos no manuseio de circuitos elétricos e familiarize-se com as práticas habituais de prevenção de acidentes. Utilize o número da instrução fornecido ao final de cada aviso para localizar sua tradução nos avisos de segurança traduzidos que acompanham este dispositivo.

GUARDE ESTAS INSTRUÇÕES

¡Advertencia! **INSTRUCCIONES IMPORTANTES DE SEGURIDAD**

Este símbolo de aviso indica peligro. Existe riesgo para su integridad física. Antes de manipular cualquier equipo, considere los riesgos de la corriente eléctrica y familiarícese con los procedimientos estándar de prevención de accidentes. Al final de cada advertencia encontrará el número que le ayudará a encontrar el texto traducido en el apartado de traducciones que acompaña a este dispositivo.

GUARDE ESTAS INSTRUCCIONES

Varning! **VIKTIGA SÄKERHETSANVISNINGAR**

Denna varningssignal signalerar fara. Du befinner dig i en situation som kan leda till personskada. Innan du utför arbete på någon utrustning måste du vara medveten om farorna med elkretsar och känna till vanliga förfaranden för att förebygga olyckor. Använd det nummer som finns i slutet av varje varning för att hitta dess översättning i de översatta säkerhetsvarningar som medföljer denna anordning.

SPARA DESSA ANVISNINGAR

FONTOS BIZTONSÁGI ELOÍRÁSOK

Ez a figyelmezeto jel veszélyre utal. Sérülésveszélyt rejto helyzetben van. Mielott bármely berendezésen munkát végezte, legyen figyelemmel az elektromos áramkörök okozta kockázatokra, és ismerkedjen meg a szokásos balesetvédelmi eljárásokkal. A kiadványban szereplo figyelmeztetések fordítása a készülékhez mellékelt biztonsági figyelmeztetések között található; a fordítás az egyes figyelmeztetések végén látható szám alapján keresheto meg.

ORIZZE MEG EZEKET AZ UTASÍTÁSOKAT!

Предупреждение **ВАЖНЫЕ ИНСТРУКЦИИ ПО СОБЛЮДЕНИЮ ТЕХНИКИ БЕЗОПАСНОСТИ**

Этот символ предупреждения обозначает опасность. То есть имеет место ситуация, в которой следует опасаться телесных повреждений. Перед эксплуатацией оборудования выясните, каким опасностям может подвергаться пользователь при использовании электрических цепей, и ознакомьтесь с правилами техники безопасности для предотвращения возможных несчастных случаев. Воспользуйтесь номером заявления, приведенным в конце каждого предупреждения, чтобы найти его переведенный вариант в переводе предупреждений по безопасности, прилагаемом к данному устройству.

СОХРАНИТЕ ЭТИ ИНСТРУКЦИИ

警告 重要的安全性说明

此警告符号代表危险。您正处于可能受到严重伤害的工作环境中。在您使用设备开始工作之前，必须充分意识到触电的危险，并熟练掌握防止事故发生的标准工作程序。请根据每项警告结尾提供的声明号码来找到此设备的安全性警告说明的翻译文本。

请保存这些安全性说明

警告 安全上の重要な注意事項

「危険」の意味です。人身事故を予防するための注意事項が記述されています。装置の取り扱い作業を行うときは、電気回路の危険性に注意し、一般的な事故防止策に留意してください。警告の各国語版は、各注意事項の番号を基に、装置に付属の「Translated Safety Warnings」を参照してください。

これらの注意事項を保管しておいてください。

주의 중요 안전 지침

이 경고 기호는 위험을 나타냅니다. 작업자가 신체 부상을 일으킬 수 있는 위험한 환경에 있습니다. 장비에 작업을 수행하기 전에 전기 회로와 관련된 위험을 숙지하고 표준 작업 관례를 숙지하여 사고를 방지하십시오. 각 경고의 마지막 부분에 있는 경고문 번호를 참조하여 이 장치와 함께 제공되는 번역된 안전 경고문에서 해당 번역문을 찾으십시오.

이 지시 사항을 보관하십시오.

Aviso **INSTRUÇÕES IMPORTANTES DE SEGURANÇA**

Este símbolo de aviso significa perigo. Você se encontra em uma situação em que há risco de lesões corporais. Antes de trabalhar com qualquer equipamento, esteja ciente dos riscos que envolvem os circuitos elétricos e familiarize-se com as práticas padrão de prevenção de acidentes. Use o número da declaração fornecido ao final de cada aviso para localizar sua tradução nos avisos de segurança traduzidos que acompanham o dispositivo.

GUARDE ESTAS INSTRUÇÕES

Advarsel **VIGTIGE SIKKERHEDSANVISNINGER**

Dette advarselssymbol betyder fare. Du befinder dig i en situation med risiko for legemesbeskadigelse. Før du begynder arbejde på udstyr, skal du være opmærksom på de involverede risici, der er ved elektriske kredsløb, og du skal sætte dig ind i standardprocedurer til undgåelse af ulykker. Brug erklæringsnummeret efter hver advarsel for at finde oversættelsen i de oversatte advarsler, der fulgte med denne enhed.

GEM DISSE ANVISNINGER

تحذير **إرشادات الأمان الهامة**

يوضح رمز التحذير هذا وجود خطر. وهذا يعني أنك متواجد في مكان قد ينتج عنه التعرض لإصابات. قبل بدء العمل، احذر مخاطر التعرض للصدمات الكهربائية وكن على علم بالإجراءات القياسية للحيلولة دون وقوع أي حوادث. استخدم رقم البيان الموجود في أخر كل تحذير لتحديد مكان ترجمته داخل تحذيرات الأمان المترجمة التي تأتي مع الجهاز.

قم بحفظ هذه الإرشادات

Upozorenje **VAŽNE SIGURNOSNE NAPOMENE**

Ovaj simbol upozorenja predstavlja opasnost. Nalazite se u situaciji koja može prouzročiti tjelesne ozljede. Prije rada s bilo kojim uređajem, morate razumjeti opasnosti vezane uz električne sklopove, te biti upoznati sa standardnim načinima izbjegavanja nesreća. U prevedenim sigurnosnim upozorenjima, priloženima uz uređaj, možete prema broju koji se nalazi uz pojedino upozorenje pronaći i njegov prijevod.

SAČUVAJTE OVE UPUTE

Upozornění **DŮLEŽITÉ BEZPEČNOSTNÍ POKYNY**

Tento upozorňující symbol označuje nebezpečí. Jste v situaci, která by mohla způsobit nebezpečí úrazu. Před prací na jakémkoliv vybavení si uvědomte nebezpečí související s elektrickými obvody a seznamte se se standardními opatřeními pro předcházení úrazům. Podle čísla na konci každého upozornění vyhledejte jeho překlad v přeložených bezpečnostních upozorněních, která jsou přiložena k zařízení.

USCHOVEJTE TYTO POKYNY

Προειδοποίηση

ΣΗΜΑΝΤΙΚΕΣ ΟΔΗΓΙΕΣ ΑΣΦΑΛΕΙΑΣ

Αυτό το προειδοποιητικό σύμβολο σημαίνει κίνδυνο. Βρίσκεστε σε κατάσταση που μπορεί να προκαλέσει τραυματισμό. Πριν εργαστείτε σε οποιοδήποτε εξοπλισμό, να έχετε υπόψη σας τους κινδύνους που σχετίζονται με τα ηλεκτρικά κυκλώματα και να έχετε εξοικειωθεί με τις συνήθεις πρακτικές για την αποφυγή ατυχημάτων. Χρησιμοποιήστε τον αριθμό δήλωσης που παρέχεται στο τέλος κάθε προειδοποίησης, για να εντοπίσετε τη μετάφρασή της στις μεταφρασμένες προειδοποιήσεις ασφαλείας που συνοδεύουν τη συσκευή.

ΦΥΛΑΞΤΕ ΑΥΤΕΣ ΤΙΣ ΟΔΗΓΙΕΣ

אזהרה

הוראות בטיחות חשובות

סימן אזהרה זה מסמל סכנה. אתה נמצא במצב העלול לגרום לפציעה. לפני שתעבוד עם ציוד כלשהו, עליך להיות מודע לסכנות הכרוכות במעגלים חשמליים ולהכיר את הנהלים המקובלים למניעת תאונות. השתמש במספר ההוראה המסופק בסופה של כל אזהרה כד לאתר את התרגום באזהרות הבטיחות המתורגמות שמצורפות להתקן.

שמור הוראות אלה

Opomena

ВАЖНИ БЕЗБЕДНОСНИ НАПАТСТВИЈА

Симболот за предупредување значи опасност. Се наоѓате во ситуација што може да предизвика телесни повреди. Пред да работите со опремата, бидете свесни за ризикот што постои кај електричните кола и треба да ги познавате стандардните постапки за спречување на несреќни случаи. Искористете го бројот на изјавата што се наоѓа на крајот на секое предупредување за да го најдете неговиот период во преведените безбедносни предупредувања што се испорачани со уредот.

ЧУВАЈТЕ ГИ ОВИЕ НАПАТСТВИЈА

Ostrzeżenie

WAŻNE INSTRUKCJE DOTYCZĄCE BEZPIECZEŃSTWA

Ten symbol ostrzeżenia oznacza niebezpieczeństwo. Zachodzi sytuacja, która może powodować obrażenia ciała. Przed przystąpieniem do prac przy urządzeniach należy zapoznać się z zagrożeniami związanymi z układami elektrycznymi oraz ze standardowymi środkami zapobiegania wypadkom. Na końcu każdego ostrzeżenia podano numer, na podstawie którego można odszukać tłumaczenie tego ostrzeżenia w dołączonym do urządzenia dokumencie z tłumaczeniami ostrzeżeń.

NINIEJSZE INSTRUKCJE NALEŻY ZACHOWAĆ

Upozornenie

DÔLEŽITÉ BEZPEČNOSTNÉ POKYNY

Tento varovný symbol označuje nebezpečenstvo. Nachádzate sa v situácii s nebezpečenstvom úrazu. Pred prácou na akomkoľvek vybavení si uvedomte nebezpečenstvo súvisiace s elektrickými obvodmi a oboznámte sa so štandardnými opatreniami na predchádzanie úrazom. Podľa čísla na konci každého upozornenia vyhľadajte jeho preklad v preložených bezpečnostných upozorneniach, ktoré sú priložené k zariadeniu.

USCHOVAJTE SI TENTO NÁVOD

Obtaining Optical Networking Information

This section contains information that is specific to optical networking products. For information that pertains to all of Cisco, refer to the Obtaining Documentation and Submitting a Service Request section.

Where to Find Safety and Warning Information

For safety and warning information, refer to the *Cisco Optical Transport Products Safety and Compliance Information* document that accompanied the product. This publication describes the international agency compliance and safety information for the Cisco ONS 15454 system. It also includes translations of the safety warnings that appear in the ONS 15454 system documentation.

Cisco Optical Networking Product Documentation CD-ROM

Optical networking-related documentation, including Cisco ONS 15xxx product documentation, is available in a CD-ROM package that ships with your product. The Optical Networking Product Documentation CD-ROM is updated periodically and may be more current than printed documentation.

Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, submitting a service request, and gathering additional information, see the monthly *What's New in Cisco Product Documentation,* which also lists all new and revised Cisco technical documentation, at:

http://www.cisco.com/en/US/docs/general/whatsnew/whatsnew.html

Subscribe to the *What's New in Cisco Product Documentation* as a Really Simple Syndication (RSS) feed and set content to be delivered directly to your desktop using a reader application. The RSS feeds are a free service and Cisco currently supports RSS version 2.0.

Shelf and FMEC Hardware

This chapter provides a description of Cisco ONS 15454 SDH shelf and backplane hardware. Card and cable descriptions are provided in Chapter 2, "Common Control Cards," Chapter 3, "Electrical Cards," Chapter 4, "Optical Cards," Chapter 5, "Ethernet Cards," and Chapter 6, "Storage Access Networking Cards." To install equipment, refer to the *Cisco ONS 15454 SDH Procedure Guide*.

Chapter topics include:

- 1.1 Overview, page 1-2
- 1.2 Front Door, page 1-3
- 1.3 Front Mount Electrical Connection, page 1-7
- 1.4 E1-75/120 Conversion Panel, page 1-9
- 1.5 Coaxial Cable, page 1-10
- 1.6 Twisted-Pair Balanced Cable, page 1-10
- 1.8 Cable Routing and Management, page 1-12
- 1.10 Fan-Tray Assembly, page 1-14
- 1.11 Power and Ground Description, page 1-16
- 1.12 Alarm, Timing, LAN, and Craft Pin Connections, page 1-16
- 1.13 Cards and Slots, page 1-16
- 1.14 Software and Hardware Compatibility, page 1-20

Note The Cisco ONS 15454 SDH assembly is intended for use with telecommunications equipment only.

Caution Unused multiservice card slots should be filled with a filler card (Cisco P/N 15454-BLANK) and unused FMEC slots should be covered with a blank faceplate (Cisco P/N 15454E-BLANK-FMEC). The filler cards and blank faceplates ensure proper airflow when operating the ONS 15454 SDH without the front door attached, although Cisco recommends that the front door remain attached.

1.1 Overview

When installed in an equipment rack, the ONS 15454 SDH assembly is typically connected to a fuse and alarm panel to provide centralized alarm connection points and distributed power for the ONS 15454 SDH. Fuse and alarm panels are third-party equipment and are not described in this documentation. If you are unsure about the requirements or specifications for a fuse and alarm panel, consult the user documentation for the related equipment. The front door of the ONS 15454 SDH allows access to the shelf assembly, fan-tray assembly, and cable-management area. The FMEC cover at the top of the shelf allows access to power connectors, external alarms and controls, timing input and output, and craft interface terminals.

You can mount the ONS 15454 SDH in an ETSI rack. The shelf assembly weighs approximately 26 kg (57 pounds) with no cards installed. The shelf assembly includes a front door and a Front Mount Electrical Connection (FMEC) cover for added security, a fan tray module for cooling, and extensive cable-management space.

All ONS 15454 SDH optical cards have SC connectors on the card faceplate, except the STM-1SH 1310-8 card, which has LC connectors. Fiber-optic cables are routed into the front of the optical and Ethernet cards. Electrical cards (E-1, E-3, DS3i, STM-1E) require FMEC cards to provide the cable connection points for the shelf assembly.

The ONS 15454 SDH is powered using –48VDC power. Negative, return, and ground power terminals are connected via the MIC-A/P and the MIC-C/T/P cards.

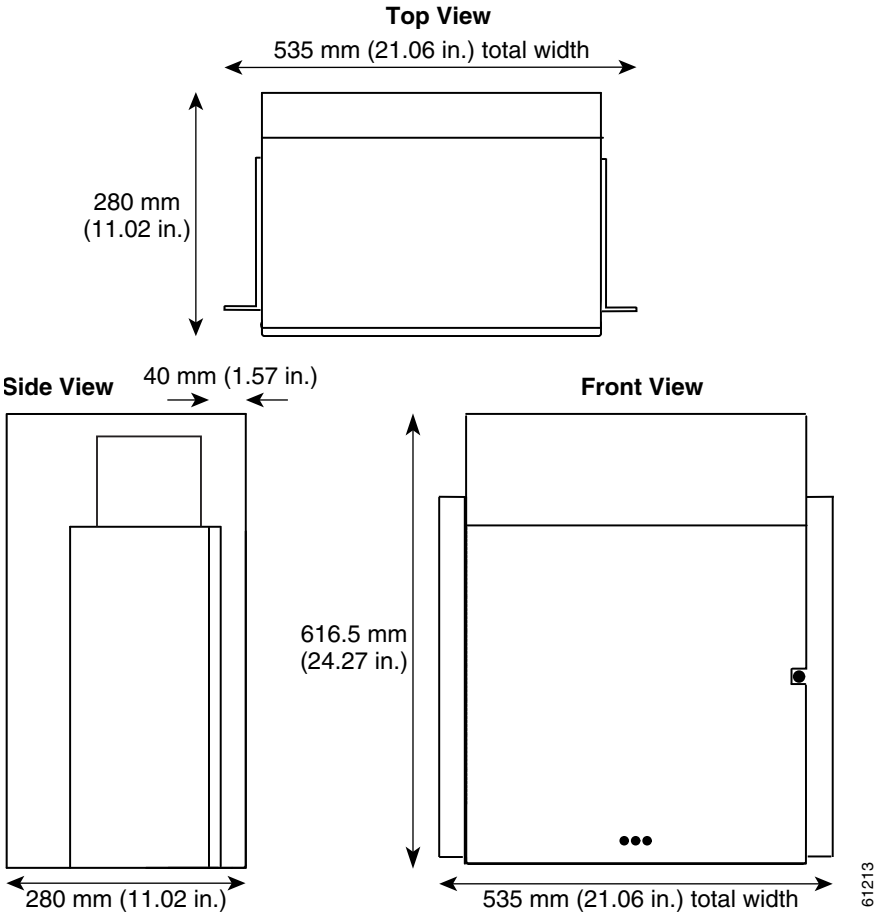
Note In this chapter, the terms “ONS 15454 SDH” and “shelf assembly” are used interchangeably. In the installation context, these terms have the same meaning. Otherwise, shelf assembly refers to the physical steel enclosure that holds cards and connects power, and ONS 15454 SDH refers to the entire system, both hardware and software.

Install the ONS 15454 SDH in compliance with your local and national electrical codes:

- United States: National Fire Protection Association (NFPA) 70; United States National Electrical Code
- Canada: Canadian Electrical Code, Part I, CSA C22.1
- Other countries: If local and national electrical codes, are not available, refer to IEC 364, Part 1 through Part 7.

Figure 1-1 provides the dimensions of the ONS 15454 SDH.

Figure 1-1 ONS 15454 SDH Dimensions

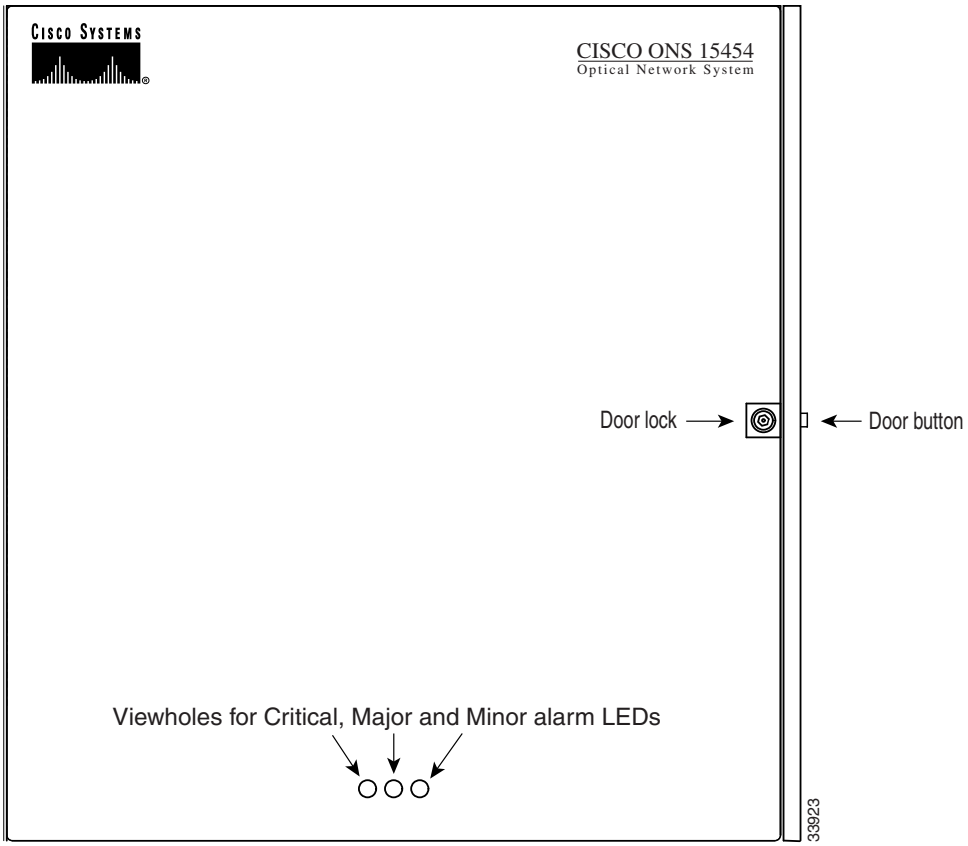


1.2 Front Door

The Critical, Major, and Minor alarm LEDs visible through the front door indicate whether a critical, major, or minor alarm is present anywhere on the ONS 15454 SDH. These LEDs must be visible so technicians can quickly determine if any alarms are present. You can use the LCD to further isolate alarms.

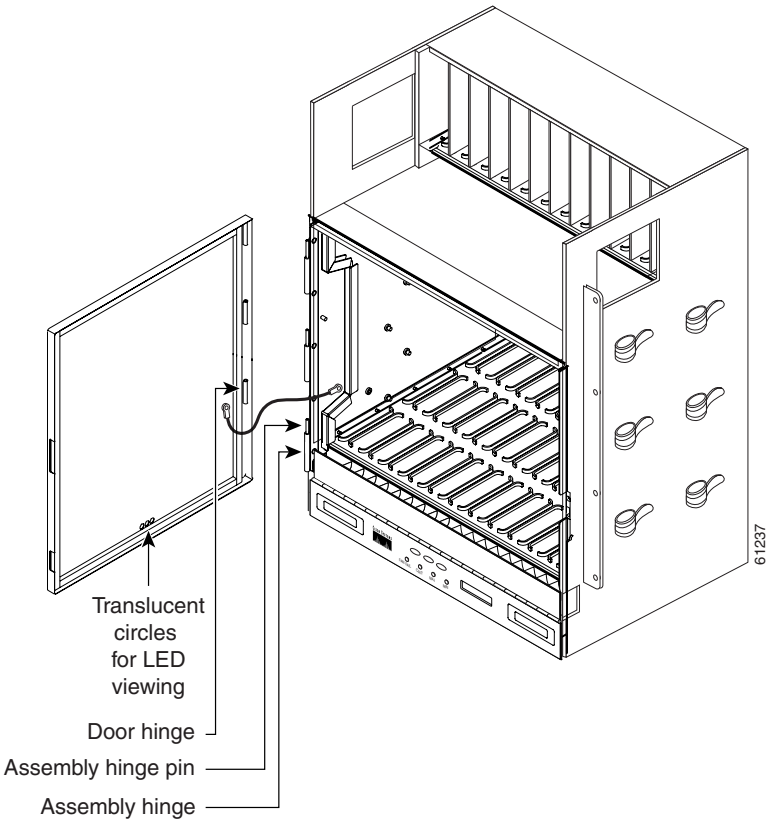
The ONS 15454 SDH features a locked door to the front compartment. A pinned hex key that unlocks the front door ships with the ONS 15454 SDH. A button on the right side of the shelf assembly releases the door. The front door provides access to the shelf assembly, cable-management tray, fan-tray assembly, and LCD screen (Figure 1-2).

Figure 1-2 The ONS 15454 SDH Front Door



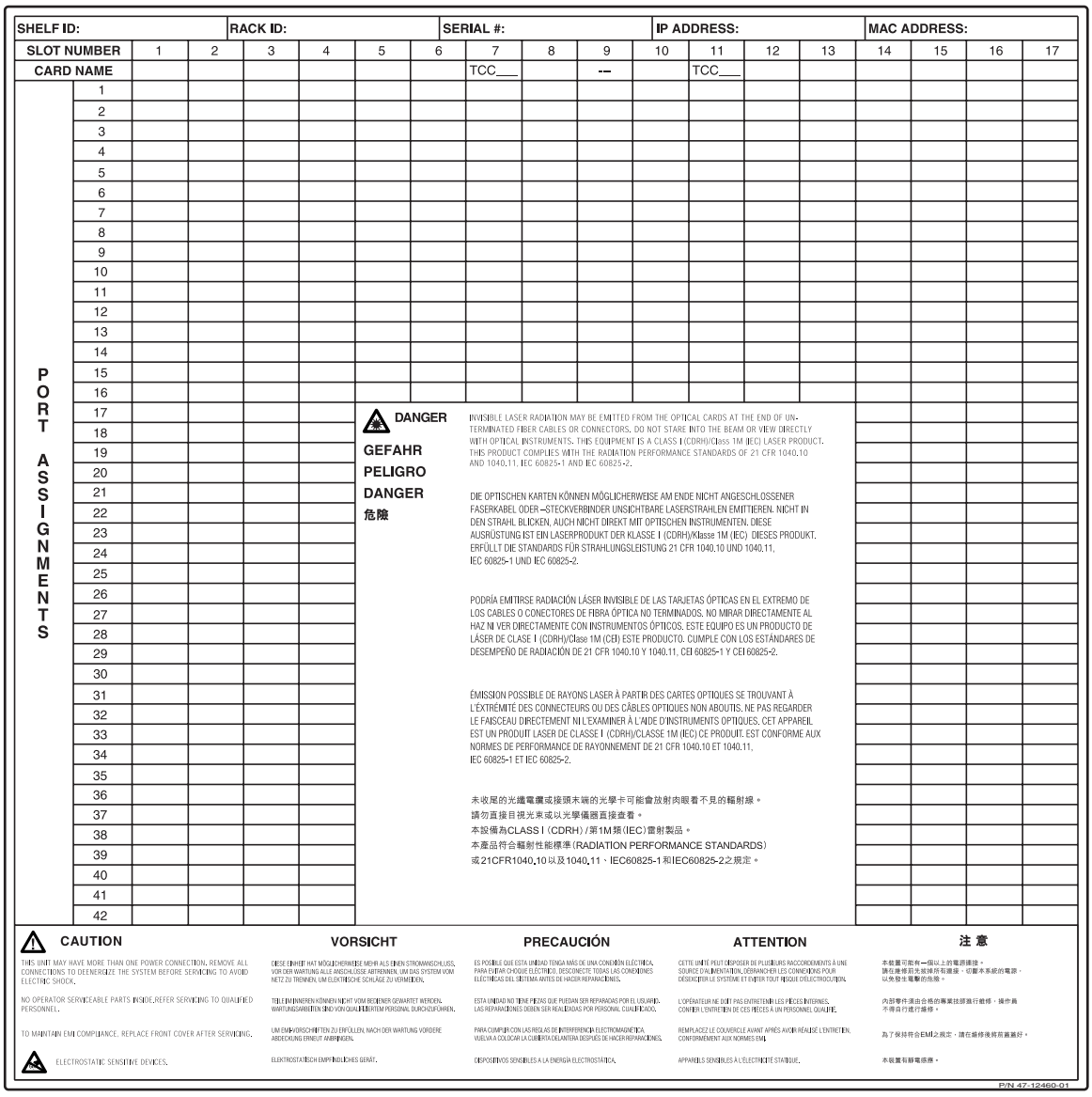
You can remove the front door of the ONS 15454 SDH to provide unrestricted access to the front of the shelf assembly (Figure 1-3).

Figure 1-3 Removing the ONS 15454 SDH Front Door



An erasable label is pasted on the inside of the front door (Figure 1-4). You can use the label to record slot assignments, port assignments, card types, node ID, rack ID, and serial number for the ONS 15454 SDH.

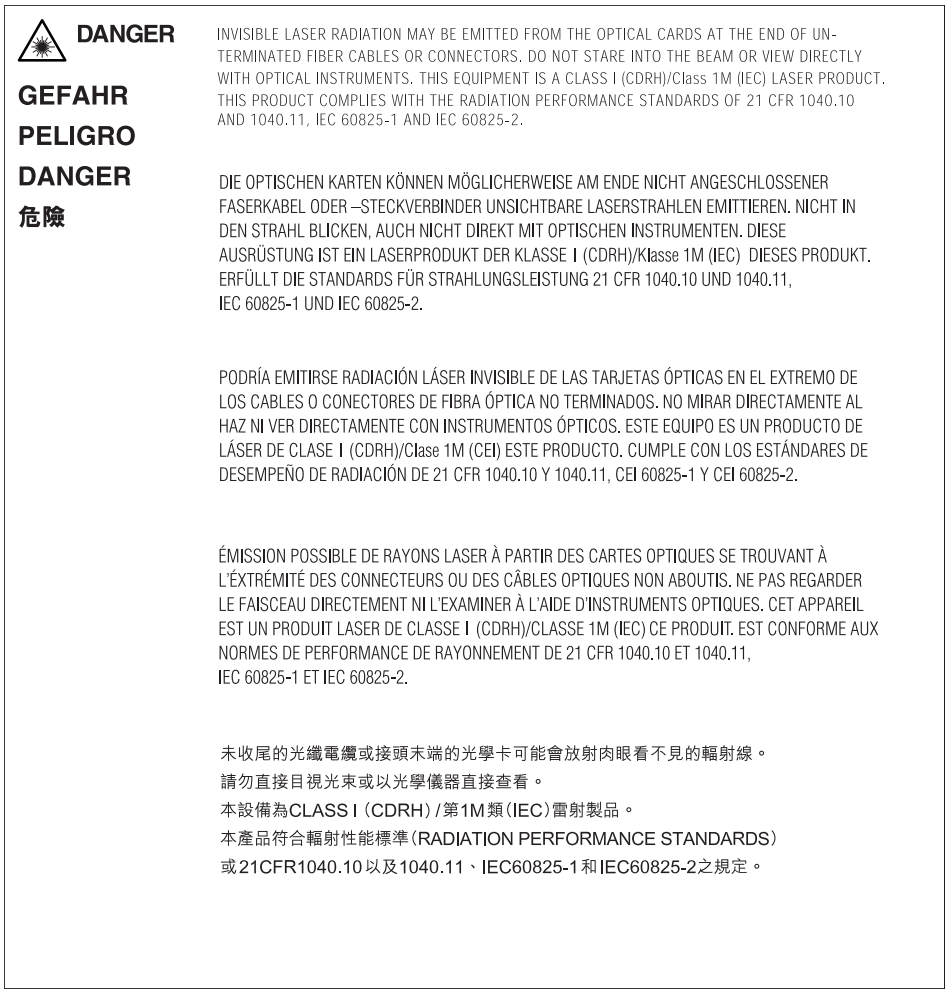
Figure 1-4 Front-Door Erasable Label


SHELF ID:
RACK ID:
SERIAL #:
IP ADDRESS:
MAC ADDRESS:
SLOT NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
CARD NAME
TCC___

TCC___
PORT ASSIGNMENTS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42
DANGER
GEFAHR
PELIGRO
DANGER
危險
INVISIBLE LASER RADIATION MAY BE EMITTED FROM THE OPTICAL CARDS AT THE END OF UN-TERMINATED FIBER CABLES OR CONNECTORS. DO NOT STARE INTO THE BEAM OR VIEW DIRECTLY WITH OPTICAL INSTRUMENTS. THIS EQUIPMENT IS A CLASS I (CDRH)/Class 1M (IEC) LASER PRODUCT. THIS PRODUCT COMPLIES WITH THE RADIATION PERFORMANCE STANDARDS OF 21 CFR 1040.10 AND 1040.11, IEC 60825-1 AND IEC 60825-2.
DIE OPTISCHEN KARTEN KÖNNEN MÖGLICHERWEISE AM ENDE NICHT ANGESCHLOSSENER FASERKABEL ODER –STECKVERBINDER UNSICHTBARE LASERSTRAHLEN EMITTIEREN. NICHT IN DEN STRAHL BLICKEN, AUCH NICHT DIREKT MIT OPTISCHEN INSTRUMENTEN. DIESE AUSRÜSTUNG IST EIN LASERPRODUKT DER KLASSE I (CDRH)/Klasse 1M (IEC) DIESES PRODUKT. ERFÜLLT DIE STANDARDS FÜR STRAHLUNGSLEISTUNG 21 CFR 1040.10 UND 1040.11, IEC 60825-1 UND IEC 60825-2.
PODRÍA EMITIRSE RADIACIÓN LÁSER INVISIBLE DE LAS TARJETAS ÓPTICAS EN EL EXTREMO DE LOS CABLES O CONECTORES DE FIBRA ÓPTICA NO TERMINADOS. NO MIRAR DIRECTAMENTE AL HAZ NI VER DIRECTAMENTE CON INSTRUMENTOS ÓPTICOS. ESTE EQUIPO ES UN PRODUCTO DE LÁSER DE CLASE I (CDRH)/Clase 1M (CEI) ESTE PRODUCTO. CUMPLE CON LOS ESTÁNDARES DE DESEMPEÑO DE RADIACIÓN DE 21 CFR 1040.10 Y 1040.11, CEI 60825-1 Y CEI 60825-2.
ÉMISSION POSSIBLE DE RAYONS LASER À PARTIR DES CARTES OPTIQUES SE TROUVANT À L'EXTRÉMITÉ DES CONNECTEURS OU DES CÂBLES OPTIQUES NON ABOUTIS. NE PAS REGARDER LE FAISCEAU DIRECTEMENT NI L'EXAMINER À L'AIDE D'INSTRUMENTS OPTIQUES. CET APPAREIL EST UN PRODUIT LASER DE CLASSE I (CDRH)/CLASSE 1M (IEC) CE PRODUIT. EST CONFORME AUX NORMES DE PERFORMANCE DE RAYONNEMENT DE 21 CFR 1040.10 ET 1040.11, IEC 60825-1 ET IEC 60825-2.
未收尾的光纖電纜或接頭末端的光學卡可能會放射肉眼看不見的輻射線。
請勿直接目視光束或以光學儀器直接查看。
本設備為CLASS I（CDRH）/第1M類(IEC)雷射製品。
本產品符合輻射性能標準(RADIATION PERFORMANCE STANDARDS)
或21CFR1040.10以及1040.11、IEC60825-1和IEC60825-2之規定。
CAUTION
THIS UNIT MAY HAVE MORE THAN ONE POWER CONNECTION. REMOVE ALL CONNECTIONS TO DEENERGIZE THE SYSTEM BEFORE SERVICING TO AVOID ELECTRIC SHOCK.
NO OPERATOR SERVICEABLE PARTS INSIDE.REFER SERVICING TO QUALIFIED PERSONNEL.
TO MAINTAIN EMI COMPLIANCE, REPLACE FRONT COVER AFTER SERVICING.
ELECTROSTATIC SENSITIVE DEVICES.
VORSICHT
DIESE EINHEIT HAT MÖGLICHERWEISE MEHR ALS EINEN STROMANSCHLUSS. VOR DER WARTUNG ALLE ANSCHLÜSSE ABTRENNEN, UM DAS SYSTEM VOM NETZ ZU TRENNEN, UM ELEKTRISCHE SCHLÄGE ZU VERMEIDEN.
TEILEINNEREN KÖNNEN NICHT VOM BEDIENER GEWARTET WERDEN. WARTUNGSARBEITEN SIND VON QUALIFIZIERTEM PERSONAL DURCHZUFÜHREN.
UM EMV-VORSCHRIFTEN ZU ERFÜLLEN, NACH DER WARTUNG VORDERE ABDECKUNG ERNEUT ANBRINGEN.
ELEKTROSTATISCH EMPFINDLICHES GERÄT.
PRECAUCIÓN
ES POSIBLE QUE ESTA UNIDAD TENGA MAS DE UNA CONEXIÓN ELÉCTRICA. PARA EVITAR CHOQUE ELÉCTRICO, DESCONECTE TODAS LAS CONEXIONES ELECTRICAS DEL SISTEMA ANTES DE HACER REPARACIONES.
ESTA UNIDAD NO TIENE PIEZAS QUE PUEDAN SER REPARADAS POR EL USUARIO. LAS REPARACIONES DEBEN SER REALIZADAS POR PERSONAL CUALIFICADO.
PARA CUMPLIR CON LAS REGLAS DE INTERFERENCIA ELECTROMAGNÉTICA VUELVA A COLOCAR LA CUBIERTA DELANTERA DESPUÉS DE HACER REPARACIONES.
DISPOSITIVOS SENSIBLES A LA ENERGÍA ELECTROSTÁTICA.
ATTENTION
CETTE UNITÉ PEUT DISPOSER DE PLUSIEURS RACCORDEMENTS À UNE SOURCE D'ALIMENTATION. DÉBRANCHER LES CONNEXIONS POUR DÉSENCLENCHER LE SYSTÈME ET EVITER TOUT RISQUE D'ÉLECTROCUTION.
L'OPÉRATEUR NE DOIT PAS ENTRETENIR LES PIÈCES INTERNES. CONFIER L'ENTRETIEN DE CES PIÈCES À UN PERSONNEL QUALIFIÉ.
REMPLACEZ LE COUVERCLE AVANT APRÈS AVOIR RÉALISÉ L'ENTRETIEN, CONFORMEMENT AUX NORMES EMI.
APPAREILS SENSIBLES À L'ÉLECTRICITÉ STATIQUE.
注 意
本裝置可能有一個以上的電源連接。
請在維修前先拔掉所有連接，切斷本系統的電源，
以免發生電擊的危險。
內部零件須由合格的專業技師進行維修。操作員
不得自行進行維修。
為了保持符合EMI之規定，請在維修後將前蓋蓋好。
本裝置有靜電敏感。
P/N 47-12460-01
124755

The front door label also includes the Class I and Class 1M laser warning (Figure 1-5).

Figure 1-5 Laser Warning on the Front-Door Label


DANGER
GEFAHR
PELIGRO
DANGER
危險
INVISIBLE LASER RADIATION MAY BE EMITTED FROM THE OPTICAL CARDS AT THE END OF UN-TERMINATED FIBER CABLES OR CONNECTORS. DO NOT STARE INTO THE BEAM OR VIEW DIRECTLY WITH OPTICAL INSTRUMENTS. THIS EQUIPMENT IS A CLASS I (CDRH)/Class 1M (IEC) LASER PRODUCT. THIS PRODUCT COMPLIES WITH THE RADIATION PERFORMANCE STANDARDS OF 21 CFR 1040.10 AND 1040.11, IEC 60825-1 AND IEC 60825-2.
DIE OPTISCHEN KARTEN KÖNNEN MÖGLICHERWEISE AM ENDE NICHT ANGESCHLOSSENER FASERKABEL ODER –STECKVERBINDER UNSICHTBARE LASERSTRAHLEN EMITTIEREN. NICHT IN DEN STRAHL BLICKEN, AUCH NICHT DIREKT MIT OPTISCHEN INSTRUMENTEN. DIESE AUSRÜSTUNG IST EIN LASERPRODUKT DER KLASSE I (CDRH)/Klasse 1M (IEC) DIESES PRODUKT. ERFÜLLT DIE STANDARDS FÜR STRAHLUNGSLEISTUNG 21 CFR 1040.10 UND 1040.11, IEC 60825-1 UND IEC 60825-2.
PODRÍA EMITIRSE RADIACIÓN LÁSER INVISIBLE DE LAS TARJETAS ÓPTICAS EN EL EXTREMO DE LOS CABLES O CONECTORES DE FIBRA ÓPTICA NO TERMINADOS. NO MIRAR DIRECTAMENTE AL HAZ NI VER DIRECTAMENTE CON INSTRUMENTOS ÓPTICOS. ESTE EQUIPO ES UN PRODUCTO DE LÁSER DE CLASE I (CDRH)/Clase 1M (CEI) ESTE PRODUCTO. CUMPLE CON LOS ESTÁNDARES DE DESEMPEÑO DE RADIACIÓN DE 21 CFR 1040.10 Y 1040.11, CEI 60825-1 Y CEI 60825-2.
ÉMISSION POSSIBLE DE RAYONS LASER À PARTIR DES CARTES OPTIQUES SE TROUVANT À L'ÉXTRÉMITÉ DES CONNECTEURS OU DES CÂBLES OPTIQUES NON ABOUTIS. NE PAS REGARDER LE FAISCEAU DIRECTEMENT NI L'EXAMINER À L'AIDE D'INSTRUMENTS OPTIQUES. CET APPAREIL EST UN PRODUIT LASER DE CLASSE I (CDRH)/CLASSE 1M (IEC) CE PRODUIT. EST CONFORME AUX NORMES DE PERFORMANCE DE RAYONNEMENT DE 21 CFR 1040.10 ET 1040.11, IEC 60825-1 ET IEC 60825-2.
未收尾的光纖電纜或接頭末端的光學卡可能會放射肉眼看不見的輻射線。
請勿直接目視光束或以光學儀器直接查看。
本設備為CLASS I（CDRH）/第1M類（IEC）雷射製品。
本產品符合輻射性能標準（RADIATION PERFORMANCE STANDARDS）
或21CFR1040.10以及1040.11、IEC60825-1和IEC60825-2之規定。
78099

1.3 Front Mount Electrical Connection

The positive and negative power terminals are located on FMEC cards in the Electrical Facility Connection Assembly (EFCA). The ground connection is the grounding receptacle on the side panel of the shelf.

The ONS 15454 SDH EFCA at the top of the shelf has 12 FMEC slots numbered sequentially from left to right (18 to 29). Slots 18 to 22 and 25 to 29 provide electrical connections. Slots 23 and 24 host the MIC-A/P and MIC-C/T/P cards, respectively.

FMEC-E1, FMEC-DS1/E1, FMEC E1-120NP, and FMEC E1-120PROA cards can be installed in Slots 18 to 21; the FMEC E1-120PROB card can be installed in Slots 26 to 29; the FMEC-E3/DS3 and FMEC STM1E 1:1 cards can be installed in Slots 18 to 21 or Slots 26 to 29. FMEC electrical card assignment is as follows:

- FMEC Slot 18 supports an electrical card in Slot 1.
- FMEC Slot 19 supports an electrical card in Slot 2.

- FMEC Slot 20 supports an electrical card in Slot 3.
- FMEC Slot 21 supports an electrical card in Slot 4.
- FMEC Slot 22 supports an electrical card in Slot 5.
- FMEC Slot 23 hosts the MIC-A/P alarm and power FMEC.
- FMEC Slot 24 supports the MIC-C/T/P timing, craft, and power FMEC.
- FMEC Slot 25 supports an electrical card in Slot 13.
- FMEC Slot 26 supports an electrical card in Slot 14.
- FMEC Slot 27 supports an electrical card in Slot 15.
- FMEC Slot 28 supports an electrical card in Slot 16.
- FMEC Slot 29 supports an electrical card in Slot 17.

FMEC slots have symbols indicating the type of cards that you can install in the slots. Each ONS 15454 SDH FMEC has a corresponding symbol. The symbol on the FMEC must match the symbol on the slot. Table 1-1 shows the slot-FMEC symbol definitions.

Table 1-1 Slot and FMEC Symbols

Color/Shape	Definition
Orange/Circle	Electrical 75-ohm E-1 connection via 1.0/2.3 miniature coax connectors. Only install ONS 15454 SDH FMECs with a circle symbol on the faceplate.
	Electrical 120-ohm E-1 connection via DB-37 connectors. Only install ONS 15454 SDH FMECs with a circle symbol on the faceplate.
	Electrical 75-ohm E3/DS3 connection via 1.0/2.3 miniature coax connectors. Only install ONS 15454 SDH FMECs with a circle symbol on the faceplate.
Green/Star	Electrical 75-ohm E1-42 and STM-1e connections via 1.0/2.3 miniature coax connectors. Only install ONS 15454 SDH FMECs with a star symbol on the faceplate.
Red/Vertical ellipse	Node power and interface for environmental alarms. Only install ONS 15454 SDH FMECs with a vertical ellipse symbol on the faceplate.
Red/Horizontal ellipse	Node power and LAN timing. Only install ONS 15454 SDH FMECs with a horizontal ellipse symbol on the faceplate.

Table 1-2 lists the number of ports, line rates, connector options, and connector locations for ONS 15454 SDH electrical FMECs.

Table 1-2 FMEC, Ports, Line Rates, and Connectors

FMEC	Ports	Line Rate per Port	Connector Type	Connector Location
FMEC-E1	14	2.048 Mbps	1.0/2.3 miniature coax connector	EFCA
FMEC-DS1/E1	14	2.048 Mbps	DB-37	EFCA
FMEC E1-120NP	42	2.048 Mbps	Molex 96-pin LFH connector	EFCA
FMEC E1-120PROA	3 to 42	2.048 Mbps	Molex 96-pin LFH connector	EFCA, Slots 18 to 21

Table 1-2 FMEC, Ports, Line Rates, and Connectors (continued)

FMEC	Ports	Line Rate per Port	Connector Type	Connector Location
FMEC E1-120PROB	3 to 42	2.048 Mbps	Molex 96-pin LFH connector	EFCA, Slots 26 to 29
FMEC-E3/DS3	12	34.368 Mbps 44.736 Mbps	1.0/2.3 miniature coax connector	EFCA
FMEC STM1E 1:1	12 (protected) or 24 (nonprotected)	155.52 Mbps	1.0/2.3 miniature coax connector	EFCA

Note The E1-120NP FMEC can only be used in Slots 18–21 and Slots 26–29. The STM1E 1:1 FMEC can only be used in Slots 18 and 19, 20 and 21, 26 and 27, or 28 and 29.

1.4 E1-75/120 Conversion Panel

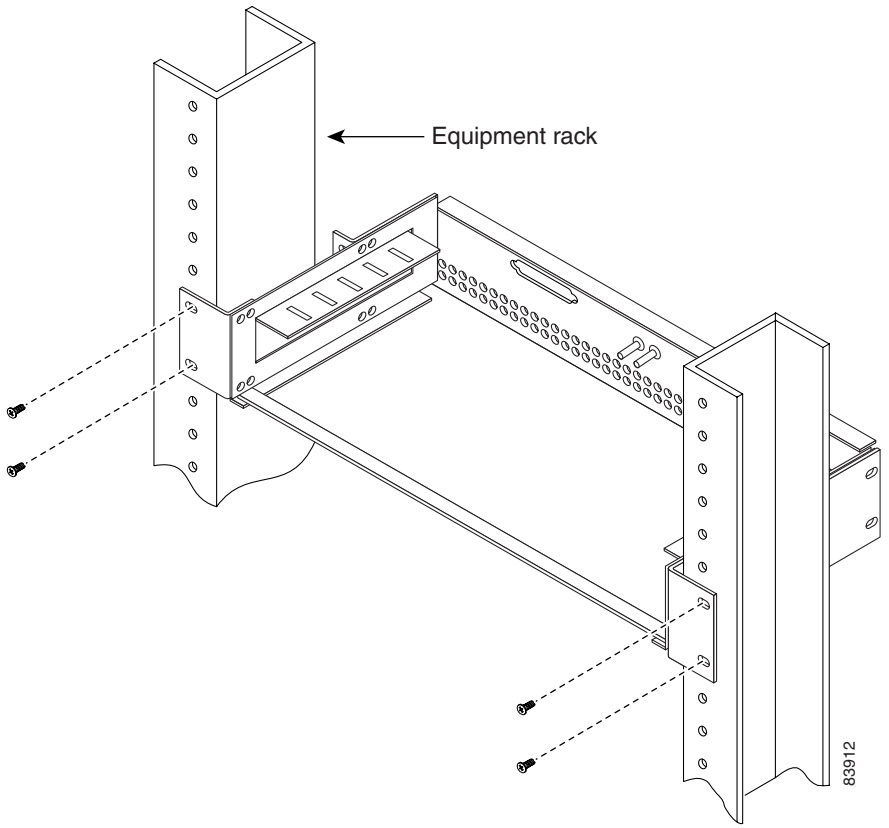
You need an E1-75/120 conversion panel if you want to convert the balanced 120-ohm interfaces of the E1-42 card and the corresponding FMECs to unbalanced 75-ohm interfaces.

The E1-75/120 contains eighty-four 1.0/2.3 miniature coax connectors (42 for transmit, 42 for receive) to the customer side and two Molex 96-pin LFH connectors to the E1-42 FMEC 120-ohm side. Each of the Molex 96-pin LFH connectors connects 21 inputs and 21 outputs. The E1-75/120 conversion panel is intended to be used in digital distribution frames (DDFs), ETSI racks, and ANSI racks.

You can install the E1-75/120 conversion panel in the rack of your ONS 15454 SDH or in a nearby rack. If you install the E1-75/120 conversion panel in a place where a longer cable is required, make sure that the total cable loss of the balanced 120-ohm cable and the unbalanced 75-ohm cable does not exceed the maximum allowed value. To ensure that the E1-75/120 conversion panel is secure, use one or two M6 mounting screws for each side of the shelf assembly. Figure 1-6 on page 1-10 shows the rack-mounting for the E1-75/120 conversion panel.

Note If required, the mounting brackets of the E1-75/120 conversion panel can be uninstalled, rotated 90 degrees, and reinstalled to enable 19-inch (482.6 mm) rack mounting.

Figure 1-6 Mounting the E1-75/120 Conversion Panel in a Rack



1.5 Coaxial Cable

Caution Always use the supplied ESD wristband when working with a powered ONS 15454 SDH. Plug the wristband cable into the ESD jack located on the lower-right outside edge of the shelf assembly.

All interfaces that are listed in Table 1-2 on page 1-8 with 1.0/2.3 miniature coax connectors (E-1, E-3, DS-3, and STM-1E) must be connected using a 75-ohm coaxial cable.

The electromagnetic compatibility (EMC) performance of the node depends on good-quality coaxial cables, such as Shuner Type G 03233 D or the equivalent.

1.6 Twisted-Pair Balanced Cable

Caution Always use the supplied ESD wristband when working with a powered ONS 15454 SDH. Plug the wristband cable into the ESD jack located on the lower-right outside edge of the shelf assembly.

All E-1 interfaces that are listed in Table 1-2 on page 1-8 with DB-37 or with Molex 96-pin LFH connectors must be connected using a 120-ohm twisted-pair balanced cable. For the interfaces that use Molex 96-pin LFH connectors Cisco offers ready-made cables.

1.7 Ethernet Cables

Ethernet cables use RJ-45 connectors, and are straight-through or crossover, depending on what is connected to them.

Table 1-3 shows 100Base-TX connector pin assignments, used with E100 Ethernet cards in the ONS 15454.

Table 1-3 E100-TX Connector Pinout

Pin	Cable Port
1	RD+
2	RD–
3	TD+
4	NC
5	NC
6	TD–
7	NC
8	NC

Figure 1-7 shows the pin locations on 100BaseT connector.

Figure 1-7 100BaseT Connector Pins

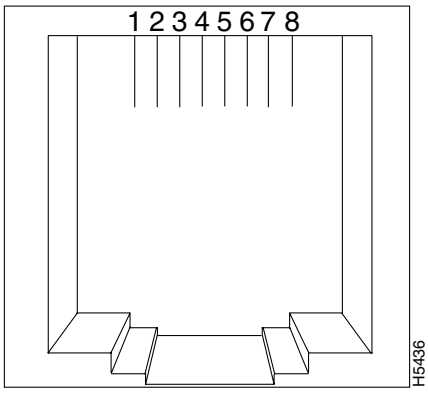


Figure 1-8 shows the straight-through Ethernet cable schematic. Use a straight-through cable when connecting to a router or a PC.

Figure 1-8 Straight-Through Cable

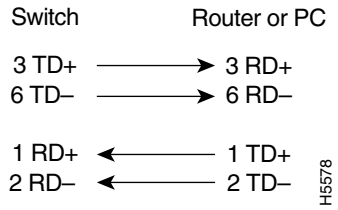
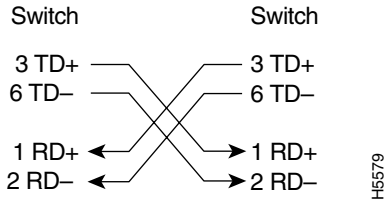


Figure 1-9 shows the crossover Ethernet cable schematic. Use a crossover cable when connecting to a switch or hub.

Figure 1-9 Crossover Cable



1.8 Cable Routing and Management

The ONS 15454 SDH cable management facilities include the following:

- A cable-routing channel (behind the fold-down door) that runs the width of the shelf assembly, Figure 1-10
- Plastic horseshoe-shaped fiber guides at each side opening of the cable-routing channel that ensure the proper bend radius is maintained in the fibers, Figure 1-11 on page 1-13

Note You can remove the fiber guide if necessary to create a larger opening (if you need to route CAT-5 Ethernet cables out the side, for example). To remove the fiber guide, take out the three screws that anchor it to the side of the shelf assembly.

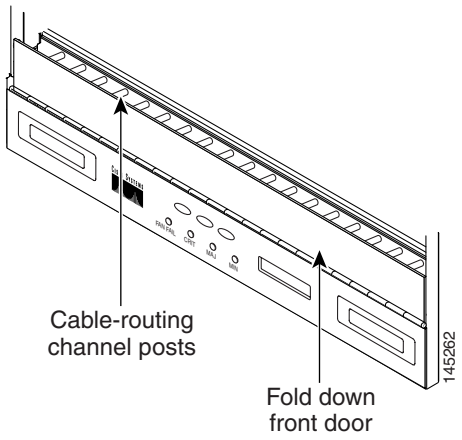
- A fold-down door that provides access to the cable-management tray
- Cable routing channel that enables you to route cables out either side

Note To remove the jumper slack storage reels, take out the screw in the center of each reel.

- Optional fiber management tray (recommended for DWDM nodes)

Figure 1-10 shows the cable management facilities that you can access through the fold-down front door, including the cable-routing channel and cable-routing channel posts.

Figure 1-10 Managing Cables on the Front Panel



1.9 Fiber Management

The jumper routing fins are designed to route fiber jumpers out of both sides of the shelf. Slots 1 to 6 exit to the left, and Slots 12 to 17 exit to the right. Figure 1-11 shows fibers routed from cards in the left slots, down through the fins, then exiting out the fiber channel to the left. The maximum capacity of the fiber routing channel depends on the size of the fiber jumpers.

Figure 1-11 Fiber Capacity

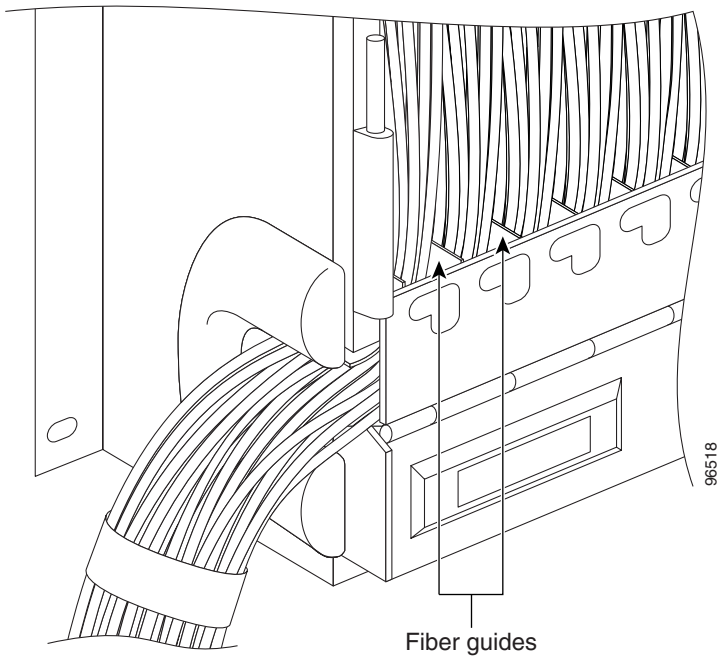


Table 1-4 provides the maximum capacity of the fiber channel for one side of a shelf, depending on fiber size and number of Ethernet cables running through that fiber channel.

Table 1-4 Fiber Channel Capacity (One Side of the Shelf)

Fiber Diameter	Maximum Number of Fibers Exiting Each Side		
	No Ethernet Cables	One Ethernet Cable	Two Ethernet Cables
1.6 mm (0.6 inch)	126	110	94
2 mm (0.7 inch)	80	70	60
3 mm (0.11 inch)	36	31	26

Plan your fiber size according to the number of cards/ports installed in each side of the shelf. For example, if your port combination requires 36 fibers, 3 mm (0.11 inch) fiber is adequate. If your port combination requires 68 fibers, you must use 2 mm (0.07 inch) or smaller fibers.

1.10 Fan-Tray Assembly

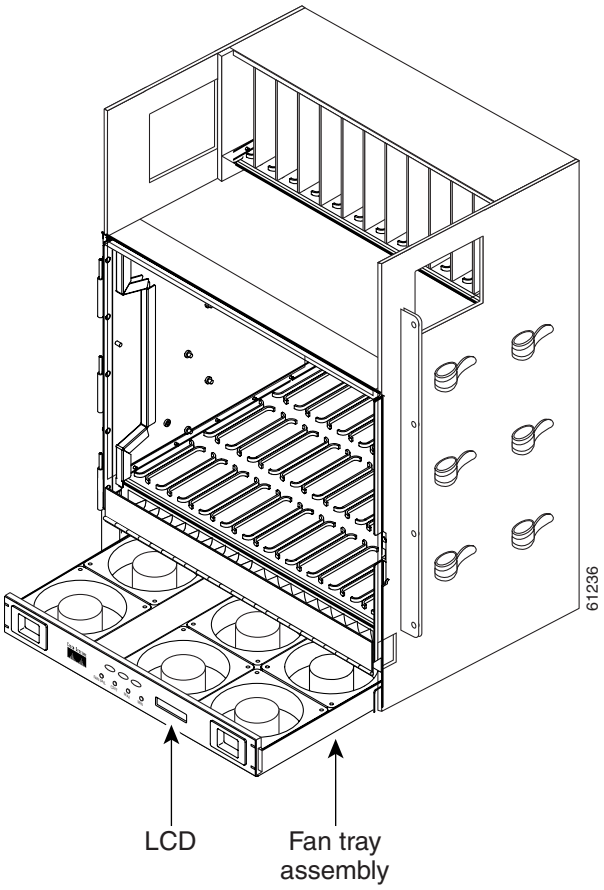
The fan-tray assembly is located at the bottom of the ONS 15454 SDH. After you install the fan-tray assembly, you only need to open the drawer if a fan fails, or if you need to replace or clean the fan-tray air filter. Do not operate an ONS 15454 SDH without a fan-tray air filter. Refer to the "Maintain the Node" chapter in the *Cisco ONS 15454 SDH Procedure Guide* for information about cleaning and maintaining the fan-tray air filter.

The fan-tray assembly is a removable drawer that holds fans and fan-control circuitry for the ONS 15454 SDH. Cisco recommends removing the front door of the chassis when removing or installing the fan-tray assembly. The front of the fan-tray assembly has an LCD screen that provides slot and port-level information for all ONS 15454 SDH card slots, including the number of critical, major, and minor alarms. For STM-N cards, you can use the LCD to determine if a port is in working or protect mode and is active or standby. It also displays whether the software load is SONET or SDH and the software version number.

The temperature measured by the TCC2/TCC2P sensors is displayed on the LCD screen.

See Figure 1-12 for the position of the fan tray assembly.

Figure 1-12 Position of the Fan-Tray Assembly



1.10.1 Fan Speed

If one or more fans fail on the fan-tray assembly, replace the entire assembly. You cannot replace individual fans. The red Fan Fail LED on the front of the fan tray illuminates when one or more fans fail. For fan tray replacement instructions, refer to the *Cisco ONS 15454 SDH Troubleshooting Guide*. The red Fan Fail LED clears after you install a working fan-tray assembly.

Fan speed is controlled by TCC2/TCC2P card temperature sensors. The sensors measure the input air temperature at the fan-tray assembly. Fan speed options are low, medium, and high. If the TCC2 card fails, the fans automatically shift to high speed. The temperature measured by the TCC2 sensors is displayed on the LCD screen.

1.10.2 Air Filter

The ONS 15454 SDH contains a reusable air filter that is installed beneath the fan-tray assembly.

The reusable filter is made of a gray, open-cell, polyurethane foam that is specially coated to provide fire and fungi resistance. Spare filters should be kept in stock. Clean the filter every three to six months. Replace the air filter every two to three years. Avoid cleaning the air filter with harsh cleaning agents or solvents.

Caution Do not operate an ONS 15454 SDH without a fan-tray air filter. A fan-tray air filter is mandatory.

1.11 Power and Ground Description

Ground the equipment according to standards or local practices.

The ONS 15454 SDH has redundant –48 VDC power connectors on the MIC-A/P and MIC-C/T/P faceplates. To install redundant power feeds, use the two power cables shipped with the ONS 15454 SDH and one ground cable. For details, see the "3.17 MIC-A/P FMEC" section on page 3-30 and the "3.18 MIC-C/T/P FMEC" section on page 3-33.

Caution Only use the power cables shipped with the ONS 15454 SDH.

1.12 Alarm, Timing, LAN, and Craft Pin Connections

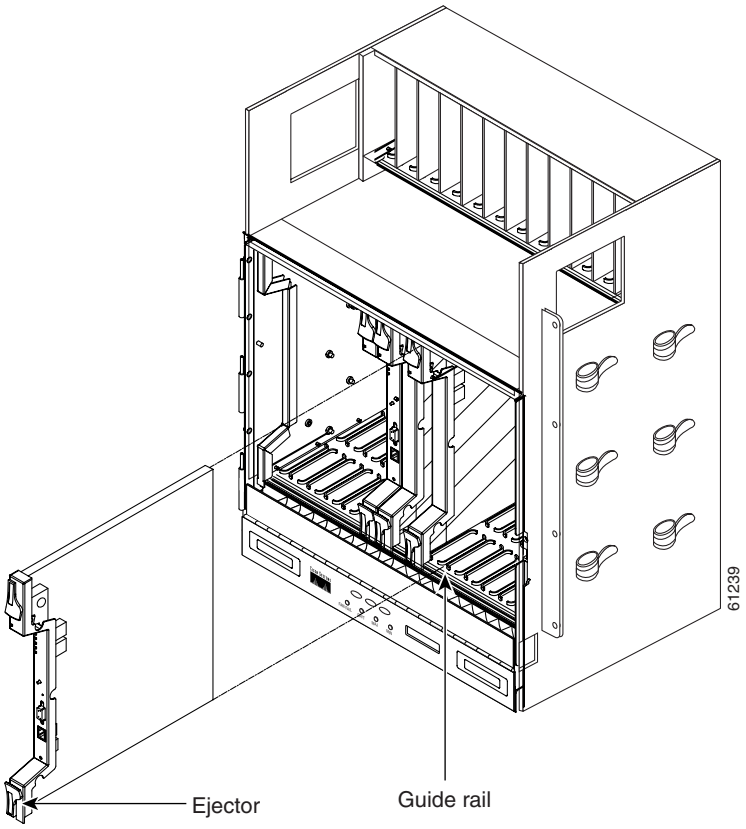
Caution Always use the supplied ESD wristband when working with a powered ONS 15454 SDH. Plug the wristband cable into the ESD jack located on the lower-right outside edge of the shelf assembly.

The MIC-A/P and the MIC-C/T/P FMECs in the EFCA area at the top of the ONS 15454 SDH shelf are used for enabling external alarms, timing input and output, and craft interface terminals to the ONS 15454 SDH. For details, see the "3.17 MIC-A/P FMEC" section on page 3-30 and the "3.18 MIC-C/T/P FMEC" section on page 3-33.

1.13 Cards and Slots

ONS 15454 SDH cards have electrical plugs at the back that plug into electrical connectors on the shelf assembly backplane. When the ejectors are fully closed, the card plugs into the assembly backplane Figure 1-13 shows card installation.

Figure 1-13 Installing Cards in the ONS 15454 SDH



1.13.1 Card Slot Requirements

The ONS 15454 SDH shelf assembly has 17 card slots numbered sequentially from left to right. Slots 1 through 6 and 12 through 17 are for traffic-bearing cards.

Slots 7 and 11 are dedicated to TCC2/TCC2P cards. Slots 8 and 10 are dedicated to cross-connect (XC-VXL-2.5G, XC-VXL-10G, XC-VXC-10G) cards. Slot 9 is reserved for the optional AIC-I card. Slots 3 and 15 can also host electrical protect cards that are used in 1:N protection.

Caution Do not operate the ONS 15454 SDH with a single TCC2/TCC2P card or a single XC-VXL-2.5G/XC-VXL-10G/XC-VXC-10G card installed. Always operate the shelf assembly with one working and one protect card of the same type.

Shelf assembly slots have symbols indicating the type of cards that you can install in them. Each ONS 15454 SDH card has a corresponding symbol. The symbol on the card must match the symbol on the slot.

Table 1-5 shows the slot and card symbol definitions.

Table 1-5 Slot and Card Symbols

Symbol Color/Shape	Definition
Orange/Circle	Slots 1 to 6 and 12 to 17. Only install ONS 15454 SDH cards with a circle symbol on the faceplate.
Blue/Triangle	Slots 5, 6, 12, and 13. Only install ONS 15454 SDH cards with circle or a triangle symbol on the faceplate.
Purple/Square	TCC2/TCC2P slot, Slots 7 and 11. Only install ONS 15454 SDH cards with a square symbol on the faceplate.
Green/Cross	Cross-connect (XC-VXL-2.5G/XC-VXL-10G) slot, that is, Slots 8 and 10. Only install ONS 15454 SDH cards with a cross symbol on the faceplate.
Red/P	Protection slot in 1:N protection schemes.
Red/Diamond	AIC-I slot, that is, Slot 9. Only install ONS 15454 SDH cards with a diamond symbol on the faceplate.
Gold/Star	Slots 1 to 4 and 14 to 17. Only install ONS 15454 SDH cards with a star symbol on the faceplate.

Table 1-6 lists the number of ports, line rates, connector options, and connector locations for ONS 15454 SDH optical and electrical cards.

Table 1-6 Card Ports, Line Rates, and Connectors

Card	Ports	Line Rate per Port	Connector Types	Connector Location
CE-100T-8	8	100 Mbps	RJ-45	Faceplate
E1-N-14	14	2.048 Mbps	1.0/2.3 miniature coax connector or DB-37	EFCA
E1-42	14	2.048 Mbps	1.0/2.3 miniature coax connector or Molex 96-pin LFH connector	EFCA
E3-12	12	34.386 Mbps	1.0/2.3 miniature coax connector	EFCA
DS3i-N-12	12	44.736 Mbps	1.0/2.3 miniature coax connector	EFCA
STM1E-12	12	Configurable 155.52 Mbps or 139.264 Mbps	1.0/2.3 miniature coax connector	EFCA
E100T-G	12	100 Mbps	RJ-45	Faceplate
E1000-2-G	2	1 Gbps	SC (GBIC)	Faceplate
G1K-4	4	1 Gbps	SC (GBIC)	Faceplate

Table 1-6 Card Ports, Line Rates, and Connectors (continued)

Card	Ports	Line Rate per Port	Connector Types	Connector Location
ML100T-12	12	100 Mbps	RJ-45	Faceplate
ML100X-8	8	100 Mbps	SC (SFP)	Faceplate
ML1000-2	2	1 Gbps	LC (SFP)	Faceplate
OC3 IR 4/STM1 SH 1310	4	155.52 Mbps (STM-1)	SC	Faceplate
OC3IR/STM1SH 1310-8	8	155.52 Mbps (STM-1)	LC	Faceplate
OC12 IR/STM4 SH 1310	1	622.08 Mbps (STM-4)	SC	Faceplate
OC12 LR/STM4 LH 1310	1	622.08 Mbps (STM-4)	SC	Faceplate
OC12 LR/STM4 LH 1550	1	622.08 Mbps (STM-4)	SC	Faceplate
OC12 IR/STM4 SH 1310-4	4	622.08 Mbps (STM-4)	SC	Faceplate
OC48 IR/STM16 SH AS 1310	1	2488.32 Mbps (STM-16)	SC	Faceplate
OC48 LR/STM16 LH AS 1550	1	2488.32 Mbps (STM-16)	SC	Faceplate
OC48 ELR/STM16 EH 100 GHz	1	2488.32 Mbps (STM-16)	SC	Faceplate
OC192 SR/STM64 IO 1310	1	9.95 Gbps (STM-64)	SC	Faceplate
OC192 IR/STM64 SH 1550	1	9.95 Gbps (STM-64)	SC	Faceplate
OC192 LR/STM64 LH 1550	1	9.95 Gbps (STM-64)	SC	Faceplate
OC192 LR/STM64 LH ITU 15xx.xx	1	9.95 Gbps (STM-64)	SC	Faceplate
FC_MR-4	4 (only 2 available in R4.6)	1.0625 Gbps	SC	Faceplate
15454_MRC-12	12	Up to 2488.32 Mbps (STM-16), depending on SFP	LC	Faceplate
OC192SR1/STM64IO Short Reach, OC192/STM64 Any Reach[1]	1	9.95 Gbps (STM-64)	LC	Faceplate

1. These cards are designated as STM64-XFP in CTC.

1.13.2 Card Replacement

To replace an ONS 15454 SDH card with another card of the same type, you do not need to make any changes to the database; remove the old card and replace it with a new card. To replace a card with a card of a different type, physically remove the card and replace it with the new card, then delete the original card from CTC. For specifics, refer to the *Cisco ONS 15454 SDH Procedure Guide.*

Caution Removing any active card from the ONS 15454 SDH can result in traffic interruption. Use caution when replacing cards and verify that only inactive or standby cards are being replaced. If the active card needs to be replaced, switch it to standby prior to removing the card from the node. For traffic switching procedures, refer to the *Cisco ONS 15454 SDH Procedure Guide*.

Note An improper removal (IMPROPRMVL) alarm is raised whenever a card pull (reseat) is performed, unless the card is deleted in CTC first. The alarm clears after the card replacement is complete.

Note In a subnetwork connection protection (SNCP), pulling the active cross-connect card without a lockout causes SNCP circuits to switch.

1.14 Software and Hardware Compatibility

Table 1-7 shows ONS 15454 SDH software and hardware compatibility for systems configured with XC-VXL-2.5G cards for Releases 4.0, 4.1, 4.6, 5.0, 6.0, and 7.0.

Table 1-7 ONS 15454 SDH Software Release/Hardware Compatibility—XC-VXL-2.5G Configurations

Hardware	4.0.0x (4.0) 4.1.0x (4.1)	4.6.0x (4.6)	5.0.0x (5.0)	6.0.0x (6.0)	7.0.0x (7.0)
XC-VXL-2.5G	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
TCC2	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
TCC2P	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
AIC-I	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
E1N-14	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
E1-42	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
E3-12	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
DS3i-N-12	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
STM1E-12	Not supported	Not supported	Fully compatible	Fully compatible	Fully compatible
E100T-G	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
E1000-2-G	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
G1000-4	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
G1K-4	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
ML100T-12	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
ML-100X-8	Not supported	Not supported	Not supported	Fully compatible	Fully compatible
ML1000-2	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
ML-MR-10	Not supported	Not supported	Not supported	Not supported	Not supported
CE-MR-10	Not supported	Not supported	Not supported	Not supported	Not supported
CE-100T-8	Not supported	Not supported	Fully compatible	Fully compatible	Fully compatible

Table 1-7 ONS 15454 SDH Software Release/Hardware Compatibility—XC-VXL-2.5G Configurations (continued)

Hardware	4.0.0x (4.0) 4.1.0x (4.1)	4.6.0x (4.6)	5.0.0x (5.0)	6.0.0x (6.0)	7.0.0x (7.0)
CE-1000-4	Not supported	Not supported	Not supported	Not supported	Fully compatible
OC3 IR 4/STM1 SH 1310	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
OC3IR/STM1SH 1310-8	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
OC12 IR/STM4 SH 1310	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
OC12 LR/STM4 LH 1310	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
OC12 LR/STM4 LH 1550	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
OC12 IR/STM4 SH 1310-4	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
OC48 IR/STM16 SH AS 1310	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
OC48 LR/STM16 LH AS 1550	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
OC48 ELR/STM16 EH 100 GHz	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
OC192 SR/STM64 IO 1310	Not supported	Not supported	Not supported	Not supported	Not supported
OC192 IR/STM64 SH 1550	Not supported	Not supported	Not supported	Not supported	Not supported
OC192 LR/STM64 LH 1550	Not supported	Not supported	Not supported	Not supported	Not supported
OC192 LR/STM64 LH ITU 15xx.xx	Not supported	Not supported	Not supported	Not supported	Not supported
OC192SR1/STM64IO Short Reach, OC192/STM64 Any Reach[1]	Not supported	Not supported	Not supported	Not supported	Not supported
MRC-12[2]	Not supported	Not supported	Not supported	Fully compatible	Fully compatible
MRC-2.5G-12	Not supported	Not supported	Not supported	Not supported	Not supported
FC_MR-4	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible

1. These cards are designated as STM64-XFP in CTC.
2. Slots 1 to 4 and 14 to 17 give a total bandwidth of up to 622 Mb/s. Slots 5, 6, 12, and 13 give a total bandwidth of up to 2.5 Gb/s

Table 1-8 shows ONS 15454 SDH software and hardware compatibility for systems configured with the XC10G, XC-VXC-10G and XC-VXL-10G cards for Releases 4.0, 4.1, 4.6, 5.0, 6.0, and 7.0. Release 4.5 is not supported on the XC10G and XC-VXL-10G cards. XC-VXC-10G is only supported from Release 6.0.

Table 1-8 ONS 15454 SDH Software Release/Hardware Compatibility—XC10G, XC-VXC-10G, and XC-VXL-10G Configuration

Hardware	4.0.0x (4.0) 4.1.0x (4.1)	4.6.0x (4.6)	5.0.0x (5.0)	6.0.0x (6.0)	7.0.0x (7.0)
TCC2/TCC2P	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
AIC-I	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
E1N-14	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
E1-42	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
E3-12	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
DS3i-N-12	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
STM1E-12	Not supported	Not supported	Fully compatible	Fully compatible	Fully compatible
RAN-SVC	Not supported	Not supported	Not supported	Not supported	Not supported
E100T-G	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
E1000-2-G	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
G1000-4	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
G1K-4	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
ML100T-12	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
ML-100X-8	Not supported	Not supported	Not supported	Fully compatible	Fully compatible
ML1000-2	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
ML-MR-10	Not supported	Not supported	Not supported	Not supported	Not supported
CE-MR-10	Not supported	Not supported	Not supported	Not supported	Not supported
CE-100T-8	Not supported	Not supported	Fully compatible	Fully compatible	Fully compatible
CE-1000-4	Not supported	Not supported	Not supported	Not supported	Fully compatible
OC3 IR 4/STM1 SH 1310	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
OC3IR/STM1SH 1310-8	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
OC12 IR/STM4 SH 1310	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
OC12 LR/STM4 LH 1310	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
OC12 LR/STM4 LH 1550	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
OC12 IR/STM4 SH 1310-4	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
OC48 IR/STM16 SH AS 1310	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
OC48 LR/STM16 LH AS 1550	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible

Table 1-8 ONS 15454 SDH Software Release/Hardware Compatibility—XC10G, XC-VXC-10G, and XC-VXL-10G Configuration (continued)

Hardware	4.0.0x (4.0) 4.1.0x (4.1)	4.6.0x (4.6)	5.0.0x (5.0)	6.0.0x (6.0)	7.0.0x (7.0)
OC48 ELR/STM16 EH 100 GHz	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
OC192 SR/STM64 IO 1310	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
OC192 IR/STM64 SH 1550	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
OC192 LR/ STM64 LH 1550	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
OC192 LR/ STM64 LH ITU 15xx.xx	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
OC192SR1/STM 64IO Short Reach, OC192/STM64 Any Reach[1]	Not supported	Not supported	Not supported	Fully compatible	Fully compatible
MRC-12[2]	Not supported	Not supported	Not supported	Fully compatible	Fully compatible
MRC-2.5G-12	Not supported	Not supported	Not supported	Not supported	Not supported
TXP_MR_10G	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
MXP_2.5G_10G	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible
FC_MR-4	Fully compatible	Fully compatible	Fully compatible	Fully compatible	Fully compatible

1. These cards are designated as STM64-XFP in CTC.
2. Slots 1 to 4 and 14 to 17 give a total bandwidth of up to 2.5Gb/s. Slots 5, 6 , 12 , and 13 give a total bandwidth of up to 10Gb/s

Note For compatibility information of DWDM cards, see the Cisco ONS 15454 DWDM Reference Manual.

If an upgrade is required for compatibility, go to the Cisco Technical Assistance Center (Cisco TAC) website at http://www.cisco.com/tac.

Common Control Cards

This chapter describes the Cisco ONS 15454 SDH common control card functions. It includes descriptions, hardware specifications, and block diagrams for each card. For installation and card turn-up procedures, refer to the *Cisco ONS 15454 SDH Procedure Guide*.

Chapter topics include:

- 2.1 Common Control Card Overview, page 2-1
- 2.2 TCC2 Card, page 2-5
- 2.3 TCC2P Card, page 2-9
- 2.4 XC-VXL-10G Card, page 2-13
- 2.5 XC-VXL-2.5G Card, page 2-15
- 2.6 XC-VXC-10G Card, page 2-17
- 2.7 AIC-I Card, page 2-21

2.1 Common Control Card Overview

The card overview section summarizes card functions and compatibility.

Each card is marked with a symbol that corresponds to a slot (or slots) on the ONS 15454 SDH shelf assembly. The cards are then installed into slots that display the same symbols. See the "1.13.1 Card Slot Requirements" section on page 1-17 for a list of slots and symbols.

2.1.1 Card Summary

Table 2-1 shows the ONS 15454 SDH common control cards and summarizes card functions.

Table 2-1 Common Control Cards for the ONS 15454 SDH

Card	Description	For Additional Information...
TCC2	The Advanced Timing, Communications, and Control (TCC2) card is the main processing center of the ONS 15454 SDH and provides system initialization, provisioning, alarm reporting, maintenance, and diagnostics.	See the "2.2 TCC2 Card" section on page 2-5.
TCC2P	The Advanced Timing, Communications, and Control Plus (TCC2P) card is the main processing center of the ONS 15454 SDH and provides system initialization, provisioning, alarm reporting, maintenance, and diagnostics. This card also has enhanced Ethernet security features.	See the "2.3 TCC2P Card" section on page 2-9.
XC-VXL-10G	The International Cross Connect 10 Gigabit AU3/AU4 High-Capacity Tributary (XC-VXL-10G) card is the central element for switching; it establishes connections and performs time-division switching (TDS). It supports cards with speeds up to 10 Gbps.	See the "2.4 XC-VXL-10G Card" section on page 2-13.
XC-VXL-2.5G	The International Cross Connect 2.5 Gigabit AU3/AU4 High-Capacity Tributary (XC-VXL-2.5G) card is the central element for switching; it establishes connections and performs TDS. It supports cards with speeds up to 2.5 Gbps.	See the "2.5 XC-VXL-2.5G Card" section on page 2-15.
XC-VXC-10G	The 10 Gigabit Cross Connect Virtual Tributary/Virtual Container (XC-VXC-10G) card serves as the switching matrix for the Cisco 15454 SDH multiservice platform. The module operates as a superset of the XC-VXL-10G or XC-VXL-2.5G cross-connect modules. The XC-VXC-10G supports cards with speeds up to 10 Gbps.	See the "2.6 XC-VXC-10G Card" section on page 2-17.
AIC-I	The Alarm Interface Controller–International (AIC-I) card provides customer-defined alarm input/output (I/O), supports user data, and supports local and express orderwire.	See the "2.7 AIC-I Card" section on page 2-21.

2.1.2 Card Compatibility

Table 2-2 lists the Cisco Transport Controller (CTC) software release compatibility for each common-control card. In the tables below, "Yes" means the card is compatible with the listed software version. Table cells with dashes mean cards are not compatible with the listed software versions.

Table 2-2 Common-Control Card Software Release Compatibility

Card	R4.0	R4.1	R4.5	R4.6	R4.7	R5.0	R6.0	R7.0
TCC2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TCC2P	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
XC10G	Yes	Yes	—	Yes	—	Yes	No	No
XC-VXL-10G	Yes	Yes	—	Yes	—	Yes	Yes	Yes
XC-VXL-2.5G	Yes	Yes	—	Yes	—	Yes	Yes	Yes
XC-VXC-10G	—	—	—	—	—	—	Yes	Yes
AIC-I	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

2.1.3 Cross-Connect Card Compatibility

The following tables list the compatible cross-connect cards for each Cisco ONS 15454 SDH common-control card. The tables are organized according to type of common-control card. In the tables below, "Yes" means the card is compatible with the listed cross-connect card. Table cells with dashes mean cards are not compatible with the listed cross-connect card.

Table 2-3 lists the cross-connect card compatibility for each common-control card.

Table 2-3 Common-Control Card Cross-Connect Compatibility

Card	XC10G Card	XC-VXL-2.5G Card	XC-VXL-10G Card	XC-VXC-10G Card
TCC2	Yes	Yes	Yes	Yes
TCC2P	Yes	Yes	Yes	Yes
XC-VXL-10G	—[1]	—[1]	Yes	—[1]
XC-VXL-2.5G	—	Yes	—[1]	—[1]
XC10G	Yes	—	—[1]	—[1]
XC-VXC-10G	—[1]	—[1]	—[1]	Yes
AIC-I	Yes	Yes	Yes	Yes

1. Cross-connect cards are compatible only during an upgrade (downgrades are not supported).

Table 2-4 lists the cross-connect card compatibility for each electrical card. "Yes" means that the electrical card is compatible with the listed cross-connect card. Table cells with dashes mean cards are not compatible with the listed cross-connect cards. For electrical card software compatibility, see Table 3-2 on page 3-4.

Table 2-4 Electrical Card Cross-Connect Compatibility

Electrical Card	XC10G Card	XC-VXL-2.5G Card	XC-VXL-10G Card	XC-VXC-10G Card
E1-N-14	Yes	Yes	Yes	Yes
E1-42	Yes	Yes	Yes	Yes
E3-12	Yes	Yes	Yes	Yes

Table 2-4 Electrical Card Cross-Connect Compatibility (continued)

Electrical Card	XC10G Card	XC-VXL-2.5G Card	XC-VXL-10G Card	XC-VXC-10G Card
DS3i-N-12	Yes	Yes	Yes	Yes
STM1E-12	—	Yes	Yes	Yes

Table 2-5 lists the cross-connect card compatibility for each optical card. "Yes" means that the optical card is compatible with the listed cross-connect card. Table cells with dashes mean cards are not compatible with the listed cross-connect cards. For optical card software compatibility, see Table 4-2 on page 4-4.

Table 2-5 Optical Card Cross-Connect Compatibility

Optical Card	XC10G Card	XC-VXL-2.5G Card	XC-VXL-10G Card	XC-VXC-10G Card
OC3 IR 4/STM1 SH 1310	Yes	Yes	Yes	Yes
OC3 IR /STM1SH 1310-8	Yes	Yes	Yes	Yes
OC12 IR/STM4 SH 1310	Yes	Yes	Yes	Yes
OC12 LR/STM4 LH 1310	Yes	Yes	Yes	Yes
OC12 LR/STM4 LH 1550	Yes	Yes	Yes	Yes
OC12 IR/STM4 SH 1310-4	Yes	**Yes**	Yes	Yes
OC48 IR/STM16 SH AS 1310	Yes	Yes	Yes	Yes
OC48 LR/STM16 LH AS 1550	Yes	Yes	Yes	Yes
OC48 ELR/STM16 EH 100 GHz	Yes	Yes	Yes	Yes
OC192 SR/STM64 IO 1310	Yes	—	Yes	Yes
OC192 IR/STM64 SH 1550	Yes	—	Yes	Yes
OC192 LR/STM64 LH 1550	Yes	—	Yes	Yes
OC192 LR/STM64 LH ITU 15xx.xx	Yes	—	Yes	Yes
OC192SR1/STM64IO Short Reach and OC192/STM64 Any Reach[1]	—	—	Yes	Yes
15454_MRC-12	—	Yes	Yes	Yes

1. Designated as STM64-XFP in CTC

Table 2-6 lists the cross-connect card compatibility for each Ethernet card.

Table 2-6 Ethernet Card Cross-Connect Compatibility

Ethernet Cards	XC10G Card	XC-VXL-2.5G Card	XC-VXL-10G Card	XC-VXC-10G Card
E100T-G	Yes	Yes	Yes	Yes
E1000-2-G	Yes	Yes	Yes	Yes
G1000-4	Yes	Yes	Yes	Yes
G1K-4	Yes	Yes	Yes	Yes
ML100T-12	Yes	Yes	Yes	Yes

Table 2-6 Ethernet Card Cross-Connect Compatibility (continued)

Ethernet Cards	XC10G Card	XC-VXL-2.5G Card	XC-VXL-10G Card	XC-VXC-10G Card
ML1000-2	Yes	Yes	Yes	Yes
ML100X-8	Yes	Yes	Yes	Yes
CE-100T-8	—	Yes	Yes	Yes
CE-1000-4	Yes	Yes	Yes	Yes

Table 2-6 lists the cross-connect card compatibility for the FC_MR-4 card. "Yes" means that the storage area network (SAN) card is compatible with the listed cross-connect card. Table cells with dashes mean cards are not compatible with the listed cross-connect cards. For software compatibility, see the "6.1.3 FC_MR-4 Compatibility" section on page 6-3.

Table 2-7 SAN Card Cross-Connect Compatibility

SAN Cards	XC10G Card	XC-VXL_2.5G Card	XC-VXL_10G Card	XC-VXC-10G Card
FC_MR-4	—	Yes	Yes	Yes

2.2 TCC2 Card

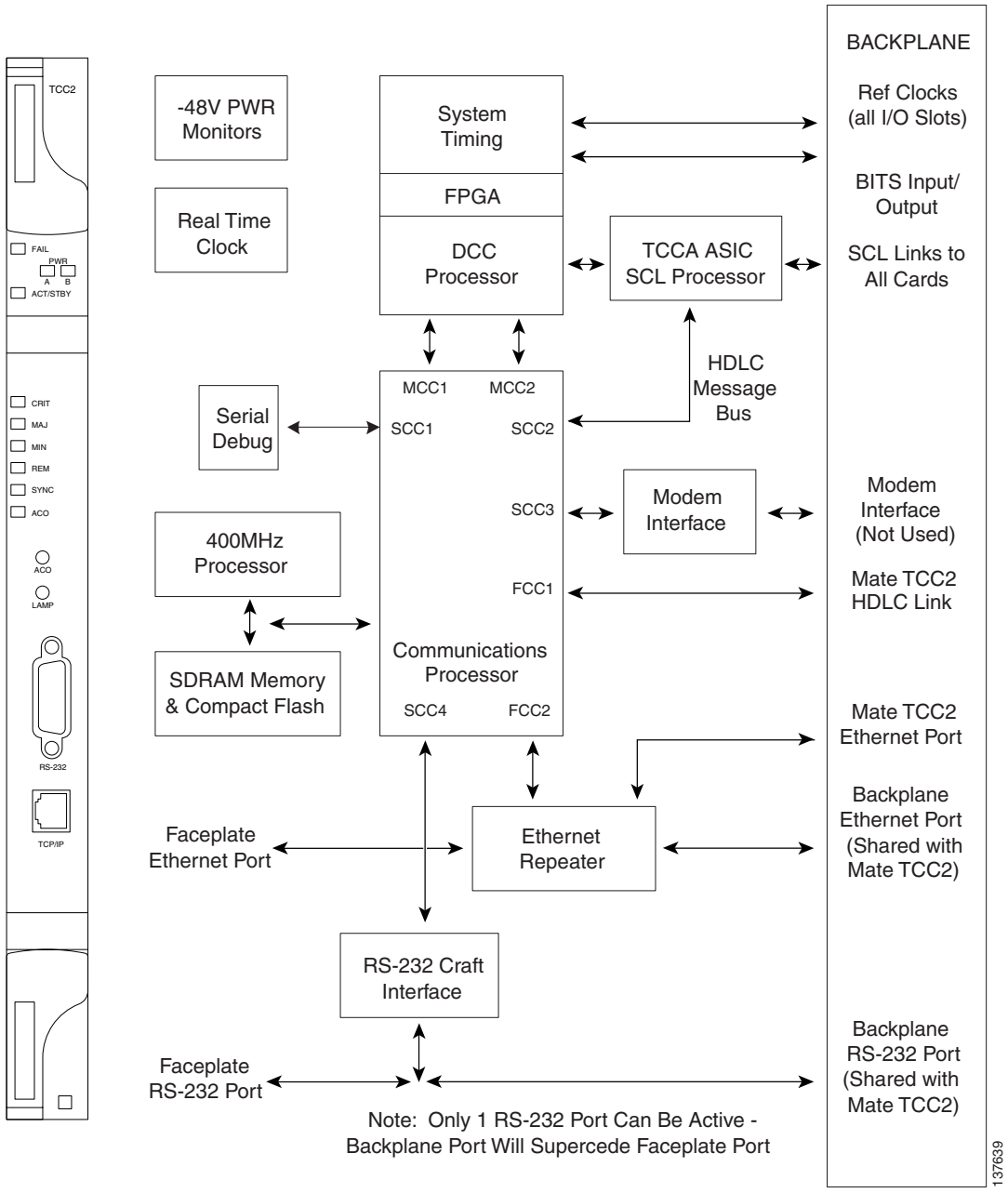
Note For TCC2 card specifications, see the "A.4.1 TCC2 Card Specifications" section on page A-10.

The TCC2 card, which requires Software Release 4.0 or later, performs system initialization, provisioning, alarm reporting, maintenance, diagnostics, IP address detection/resolution, SDH section overhead (SOH) data communications channel/generic communication channel (DCC/GCC) termination, and system fault detection for the ONS 15454 SDH. The TCC2 card also ensures that the system maintains Stratum 3 timing requirements. It monitors the supply voltage of the system.

Note The LAN interfaces of the TCC2 card meet the standard Ethernet specifications by supporting a cable length of 100 m (328 ft.) at temperatures from 0 to 65 degrees Celsius (32 to 149 degrees Fahrenheit). The interfaces can operate with a cable length of 10 m (32.8 ft) maximum at temperatures from –40 to 0 degrees Celsius (–40 to 32 degrees Fahrenheit).

Figure 2-1 shows the TCC2 card faceplate and block diagram.

Figure 2-1 TCC2 Faceplate and Block Diagram



2.2.1 TCC2 Card Functionality

The TCC2 card supports multichannel, high-level data link control (HDLC) processing for the DCC/GCC. Up to 84 DCCs can be routed over the TCC2 card and up to 84 section DCCs can be terminated at the TCC2 card (subject to the available optical digital communication channels). The TCC2 card selects and processes 84 DCCs to facilitate remote system management interfaces.

The TCC2 card also originates and terminates a cell bus carried over the module. The cell bus supports links between any two cards in the node, which is essential for peer-to-peer communication. Peer-to-peer communication accelerates protection switching for redundant cards.

The node database, IP address, and system software are stored in TCC2 card nonvolatile memory, which allows quick recovery in the event of a power or card failure.

The TCC2 card performs all system-timing functions for each ONS 15454 SDH. It monitors the recovered clocks from each traffic card and two building integrated timing supply (BITS) ports (E1, 2.048 MHz) for frequency accuracy. The TCC2 card selects a recovered clock, a BITS, or an internal Stratum 3 reference as the system-timing reference. You can provision any of the clock inputs as primary or secondary timing sources. A slow-reference tracking loop allows the TCC2 card to synchronize with the recovered clock, which provides holdover if the reference is lost.

The TCC2 card monitors both supply voltage inputs on the shelf. An alarm is generated if one of the supply voltage inputs has a voltage outside of the specified range.

Install TCC2 cards in Slots 7 and 11 for redundancy. If the active TCC2 card fails, traffic switches to the protect TCC2 card. All TCC2 card protection switches conform to protection switching standards when the bit error rate (BER) counts are not in excess of 1 * 10 exp – 3 and completion time is less than 50 ms.

The TCC2 card has two built-in interface ports for accessing the system: an RJ-45 10BaseT LAN interface and an EIA/TIA-232 interface for local craft access. It also has a 10BaseT LAN port for user interfaces through the backplane to the port accessible on the MIC-C/T/P Front Mount Electrical Connection (FMEC).

Note When using the LAN RJ-45 craft interface or back panel wirewrap LAN connection, the connection must be 10BASE T, half duplex. Full duplex and autonegotiate settings should not be used because they might result in a loss of visibility to the node.

Note Cisco does not support operation of the ONS 15454 SDH with only one TCC2 card. For full functionality and to safeguard your system, always operate each ONS 15454 SDH with two TCC2 cards.

Note CTC software does not monitor for the absence of FMECs until the TCC2 card(s) have reached the Active/Standby state. During transitional states such as power-up or TCC2 card reset, CTC ignores the FMEC inventory displayed in node view.

Note When a second TCC2 card is inserted into a node, it synchronizes its software, its backup software, and its database with the active TCC2 card. If the software version of the new TCC2 card does not match the version on the active TCC2 card, the newly inserted TCC2 card copies from the active TCC2 card, taking about 15 to 20 minutes to complete. If the backup software version on the new TCC2 card does not match the version on the active TCC2 card, the newly inserted TCC2 card copies the backup software from the active TCC2 card again, taking about 15 to 20 minutes. Copying the database from the active TCC2 card takes about 3 minutes. Depending on the software version and backup version the new TCC2 card started with, the entire process can take between 3 and 40 minutes.

2.2.2 TCC2 Card-Level Indicators

Table 2-8 describes the two card-level LEDs on the TCC2 card faceplate.

Table 2-8 TCC2 Card-Level Indicators

Card-Level LEDs	Definition
Red FAIL LED	The FAIL LED flashes during the boot and write process. Replace the card if the FAIL LED persists.
ACT/STBY LED Green (Active) Amber (Standby)	The ACT/STBY (Active/Standby) LED indicates the TCC2 card is active (green) or in standby (amber) mode. The ACT/STBY LED also provides the timing reference and shelf control. When the TCC2 card is writing to the active or standby TCC2 card, its active or standby LED blinks. To avoid memory corruption, do not remove the TCC2 card when the active or standby LED is blinking.

2.2.3 Network-Level Indicators

Table 2-9 describes the six network-level LEDs on the TCC2 card faceplate.

Table 2-9 TCC2 Network-Level Indicators

System-Level LEDs	Definition
Red CRIT LED	Indicates Critical alarms in the network at the local terminal.
Red MAJ LED	Indicates Major alarms in the network at the local terminal.
Amber MIN LED	Indicates Minor alarms in the network at the local terminal.
Red REM LED	Provides first-level alarm isolation. The remote (REM) LED turns red when an alarm is present in one or several of the remote terminals.
Green SYNC LED	Indicates that node timing is synchronized to an external reference.
Green ACO LED	After pressing the alarm cutoff (ACO) button, the green ACO LED illuminates. The ACO button opens the audible closure on the backplane. ACO state is stopped if a new alarm occurs. After the originating alarm is cleared, the ACO LED and audible alarm control are reset.

2.2.4 Power-Level Indicators

Table 2-10 describes the two power-level LEDs on the TCC2 faceplate.

Table 2-10 TCC2 Power-Level Indicators

Power-Level LEDs	Definition
Green/Red PWR A LED	The PWR A LED is green when the voltage on supply input A is between the extremely low battery voltage (ELWBATVG) and extremely high battery voltage (EHIBATVG) thresholds. The LED is red when the voltage on supply input A is above extremely high battery voltage or below extremely low battery voltage thresholds.
Green/Red PWR B LED	The PWR B LED is green when the voltage on supply input B is between the extremely low battery voltage (ELWBATVG) and extremely high battery voltage (EHIBATVG) thresholds. The LED is red when the voltage on supply input B is above extremely high battery voltage or below extremely low battery voltage thresholds.

2.3 TCC2P Card

Note For TCC2P card specifications, see the "A.4.2 TCC2P Card Specifications" section on page A-10.

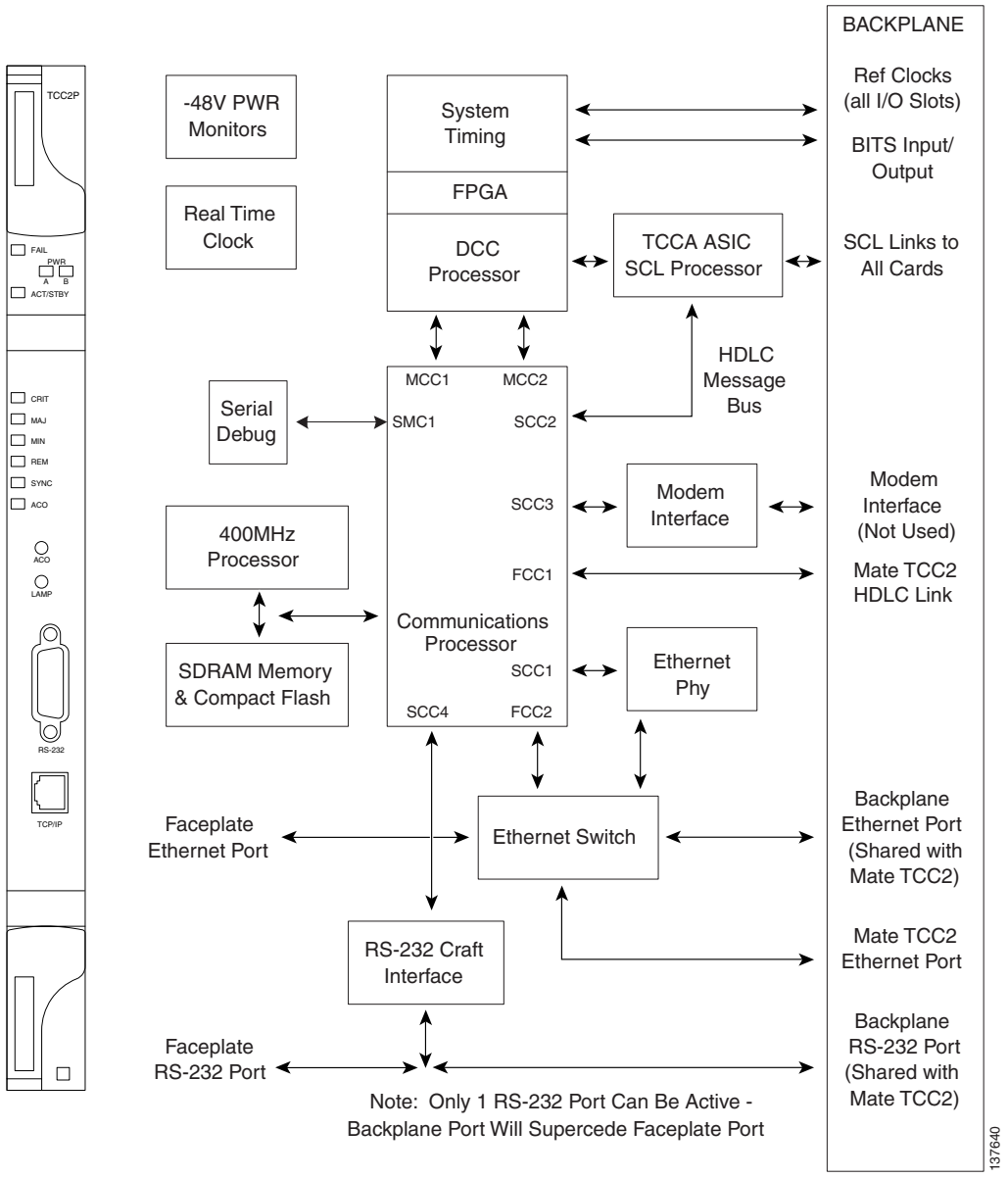
The TCC2P card, which requires Software R4.0 or later, is an enhanced version of the TCC2 card. The primary enhancements are Ethernet security features in R5.0 and 64kHz+8kHz clocking in R6.0.

The TCC2P card performs system initialization, provisioning, alarm reporting, maintenance, diagnostics, IP address detection/resolution, SDH regeneration section overhead (RSOH) and multiplex section overhead (MSOH) DCC/GCC termination, and system fault detection for the ONS 15454. The TCC2P also ensures that the system maintains Stratum 3 (ITU-T G.812) timing requirements. It monitors the supply voltage of the system.

Note The LAN interface of the TCC2P card meets the standard Ethernet specifications by supporting a cable length of 328 ft (100 m) at temperatures from 32 to 149 degrees Fahrenheit (0 to 65 degrees Celsius). The interfaces can operate with a cable length of 32.8 ft (10 m) maximum at temperatures from –40 to 32 degrees Fahrenheit (–40 to 0 degrees Celsius).

Figure 2-2 shows the faceplate and block diagram for the TCC2P card.

Figure 2-2 TCC2P Faceplate and Block Diagram



2.3.1 TCC2P Functionality

The TCC2P card supports multichannel, HDLC processing for the DCC. Up to 84 DCCs can be routed over the TCC2P card and up to 84 section DCCs can be terminated at the TCC2P card (subject to the available optical digital communication channels). The TCC2P selects and processes 84 DCCs to facilitate remote system management interfaces.

The TCC2P also originates and terminates a cell bus carried over the module. The cell bus supports links between any two cards in the node, which is essential for peer-to-peer communication. Peer-to-peer communication accelerates protection switching for redundant cards.

The node database, IP address, and system software are stored in TCC2P nonvolatile memory, which allows quick recovery in the event of a power or card failure.

The TCC2P card performs all system-timing functions for each ONS 15454. It monitors the recovered clocks from each traffic card and two BITS ports for frequency accuracy. The TCC2P card selects a recovered clock, a BITS, or an internal Stratum 3 reference as the system-timing reference. You can provision any of the clock inputs as primary or secondary timing sources. A slow-reference tracking loop allows the TCC2P to synchronize with the recovered clock, which provides holdover if the reference is lost.

For Software Release 6.0 and later, the TCC2P card supports a 64 kHz + 8 kHz composite clock BITS IN as well as a BITS OUT clock of 6.312 MHz. The BITS on the system is configurable as E1, 2.048 MHz, or 64 kHz, with E1 being the default. The BITS OUT clock runs at a rate determined by BITS IN, as shown in Table 2-11.

Table 2-11 BITS Clocks

BITS IN	BITS OUT
E1	E1 (default)
2.048 MHz (square wave clock)	2.048 MHz (square wave clock)
64 kHz	6.312 MHz

A BITS output interface configured as 6.312 MHz complies with ITU-T G.703, Appendix II, Table II.4, with a monitor level of –40 dBm +/– 4 dBm.

The TCC2P monitors both supply voltage inputs on the shelf. An alarm is generated if one of the supply voltage inputs has a voltage that is out of the specified range.

Install TCC2P cards in Slots 7 and 11 for redundancy. If the active TCC2P fails, traffic switches to the protect TCC2P. All TCC2P protection switches conform to protection switching standards when the BER counts are not in excess of 1 * 10 exp – 3 and completion time is less than 50 ms.

The TCC2P card has two built-in RJ-45 Ethernet interface ports for accessing the system: one on the front faceplate for on-site craft access and a second by means of the backplane to the port that is accessible on the MIC-C/T/P FMEC, for user interfaces. The FMEC Ethernet interface is for permanent LAN access and all remote access via TCP/IP as well as for Operations Support System (OSS) access. The Ethernet interfaces have different IP addresses that are in different subnets.

An EIA/TIA-232 serial port on the faceplate allows for a craft interface in TL1 mode.

Note When using the LAN RJ-45 craft interface or back panel wirewrap LAN connection, the connection must be 10BASE T, half duplex. Full duplex and autonegotiate settings should not be used because they might result in a loss of visibility to the node.

Note Cisco does not support operation of the ONS 15454 SDH with only one TCC2P card. For full functionality and to safeguard your system, always operate with two TCC2P cards.

Note When a second TCC2P card is inserted into a node, it synchronizes its software, its backup software, and its database with the active TCC2P. If the software version of the new TCC2P does not match the version on the active TCC2P, the newly inserted TCC2P copies from the active TCC2P, taking about 15 to 20 minutes to complete. If the backup software version on the new TCC2P does not match the version on the active TCC2P, the newly inserted TCC2P copies the backup software from the active TCC2P again, taking about 15 to 20 minutes. Copying the database from the active TCC2P takes about 3 minutes. Depending on the software version and backup version the new TCC2P started with, the entire process can take between 3 and 40 minutes.

2.3.2 TCC2P Card-Level Indicators

The TCC2P faceplate has ten LEDs. Table 2-12 describes the two card-level LEDs on the TCC2P faceplate.

Table 2-12 TCC2P Card-Level Indicators

Card-Level LEDs	Definition
Red FAIL LED	This LED is on during reset. The FAIL LED flashes during the boot and write process. Replace the card if the FAIL LED persists.
ACT/STBY LED Green (Active) Amber (Standby)	Indicates the TCC2P is active (green) or in standby (amber) mode. The ACT/STBY LED also provides the timing reference and shelf control. When the active TCC2P is writing to its database or to the standby TCC2P database, the card LEDs blink. To avoid memory corruption, do not remove the TCC2P when the active or standby LED is blinking.

2.3.3 Network-Level Indicators

Table 2-13 describes the six network-level LEDs on the TCC2P faceplate.

Table 2-13 TCC2P Network-Level Indicators

System-Level LEDs	Definition
Red CRIT LED	Indicates Critical alarms in the network at the local terminal.
Red MAJ LED	Indicates Major alarms in the network at the local terminal.
Amber MIN LED	Indicates Minor alarms in the network at the local terminal.
Red REM LED	Provides first-level alarm isolation. The remote (REM) LED turns red when an alarm is present in one or more of the remote terminals.
Green SYNC LED	Indicates that node timing is synchronized to an external reference.
Green ACO LED	After pressing the ACO button, the ACO LED turns green. The ACO button opens the audible alarm closure on the backplane. ACO is stopped if a new alarm occurs. After the originating alarm is cleared, the ACO LED and audible alarm control are reset.

2.3.4 Power-Level Indicators

Table 2-14 describes the two power-level LEDs on the TCC2P faceplate.

Table 2-14 TCC2P Power-Level Indicators

Power-Level LEDs	Definition
Green/Red PWR A LED	The PWR A LED is green when the voltage on supply input A is between the extremely low battery voltage (ELWBATVG) and extremely high battery voltage (EHIBATVG) thresholds. The LED is red when the voltage on supply input A is above extremely high battery voltage or below extremely low battery voltage thresholds.
Green/Red PWR B LED	The PWR B LED is green when the voltage on supply input B is between the extremely low battery voltage (ELWBATVG) and extremely high battery voltage (EHIBATVG) thresholds. The LED is red when the voltage on supply input B is above extremely high battery voltage or below extremely low battery voltage thresholds.

2.4 XC-VXL-10G Card

Note For XC-VCL-10G card specifications, see the "A.4.3 XC-VXL-10G Card Specifications" section on page A-11.

The XC-VXL-10G card cross connects E-1, E-3, DS-3, STM-1, STM-4, STM-16, and STM-64 signal rates. The XC-VXL-10G provides a maximum of 384 x 384 VC-4 nonblocking cross-connections, 384 x 384 VC-3 nonblocking cross-connections, or 2016 x 2016 VC-12 nonblocking cross-connections. It is designed for 10-Gbps solutions.

Figure 2-3 shows the XC-VXL-10G faceplate and block diagram.

Figure 2-3 XC-VXL-10G Faceplate and Block Diagram

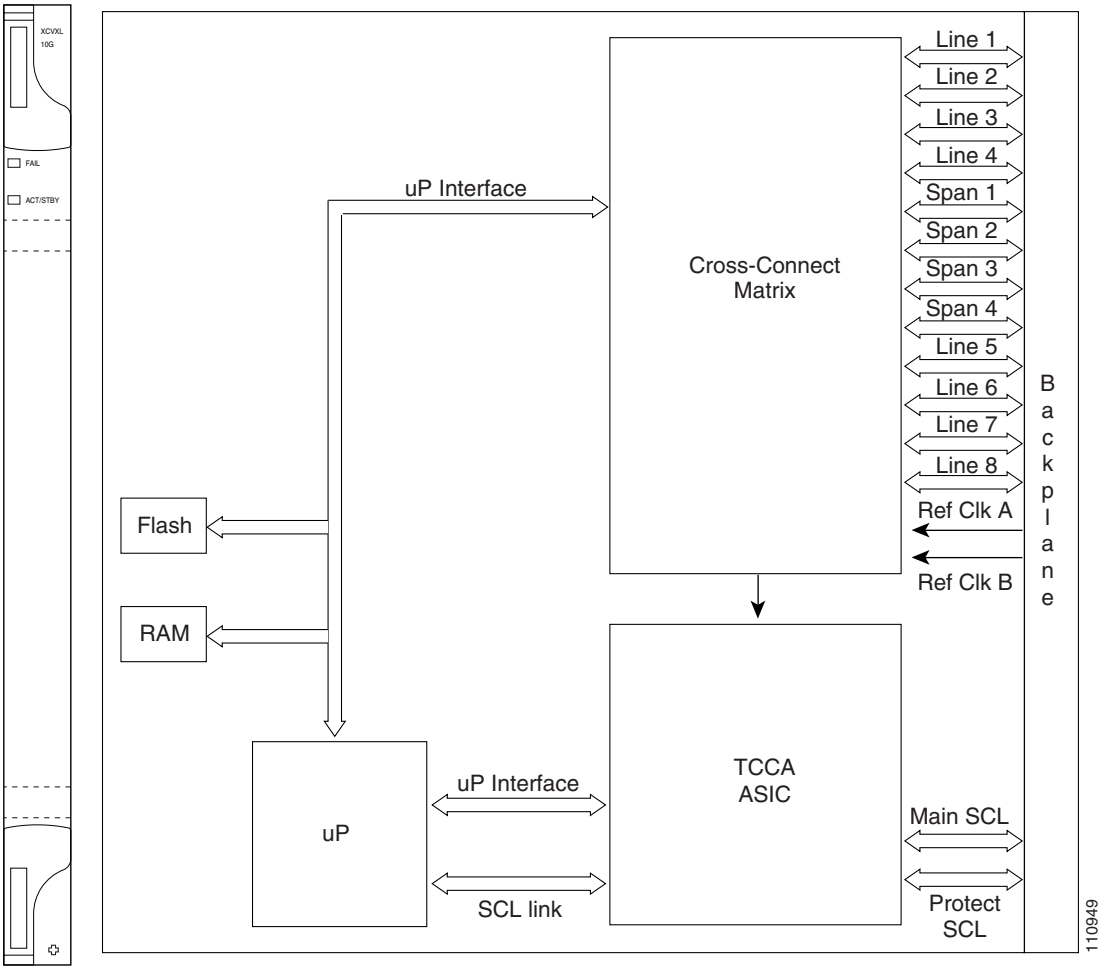
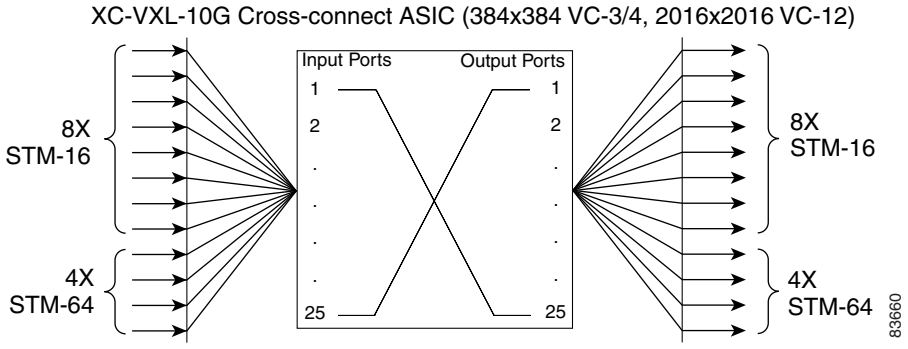


Figure 2-4 shows the XC-VXL-10G cross-connect matrix.

Figure 2-4 XC-VXL-10G Cross-Connect Matrix



2.4.1 XC-VXL-10G Functionality

The XC-VXL-10G card manages up to 192 bidirectional STM-1 cross-connects, 192 bidirectional E-3 or DS-3 cross-connects, or 1008 bidirectional E-1 cross-connects. The TCC2/TCC2P card assigns bandwidth to each slot on a per-STM-1 basis. The XC-VXL-10G card works with the TCC2/TCC2P card to maintain connections and set up cross-connects within the node. You can establish cross-connect and provisioning information through CTC.

Note Cisco does not support operating the ONS 15454 SDH with only one XC-VXL-10G card. Always operate in a redundant configuration. Install the XC-VXL-10G cards in Slots 8 and 10.

2.4.2 XC-VXL-10G Card-Level Indicators

Table 2-15 describes the two card-level LEDs on the XC-VXL-10G card faceplate.

Table 2-15 XC-VXL-10G Card-Level Indicators

Card-Level LEDs	Definition
Red FAIL LED	Indicates that the card's processor is not ready. The FAIL LED is on during reset and flashes during the boot process. Replace the card if the red FAIL LED persists.
ACT/STBY LED Green (Active) Amber (Standby)	Indicates whether the XC-VXL-10G card is active and carrying traffic (green) or in standby mode to the active XC-VXL-10G card (amber).

2.5 XC-VXL-2.5G Card

Note For XC-VXL-2.5G card specifications, see the "A.4.4 XC-VXL-2.5G Card Specifications" section on page A-12.

The XC-VXL-2.5G card cross-connects E-1, E-3, DS-3, STM-1, STM-4, STM-16, and STM-64 signal rates. The XC-VXL-2.5G card provides a maximum of 192 x 192 VC-4 nonblocking cross-connections, 384 x 384 VC-3 nonblocking cross-connections, or 2016 x 2016 VC-12 nonblocking cross-connections. The card is designed for 2.5-Gbps solutions.

Figure 2-5 shows the XC-VXL-2.5G card faceplate and block diagram.

Figure 2-5 XC-VXL-2.5G Faceplate and Block Diagram

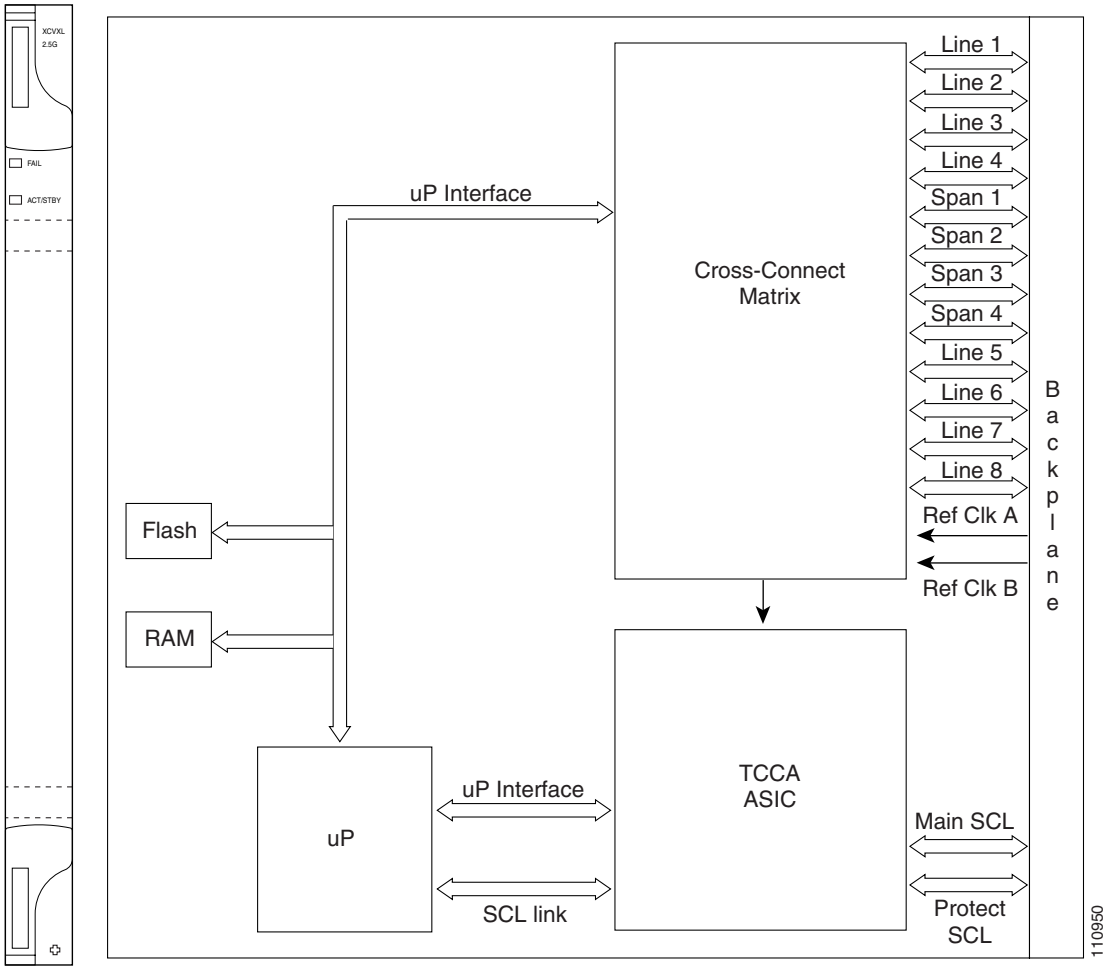
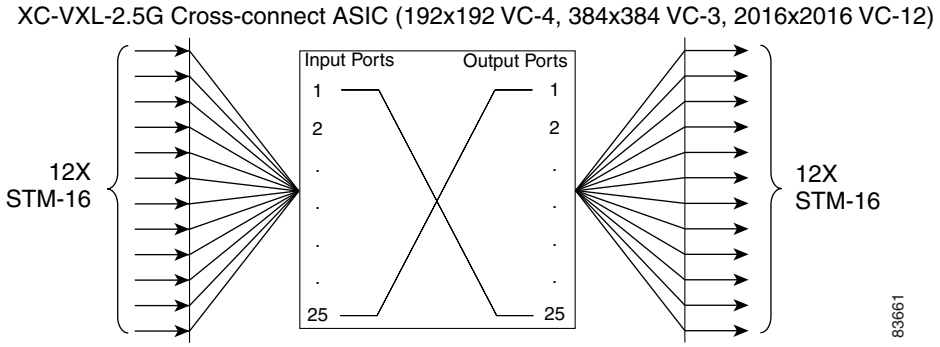


Figure 2-6 shows the XC-VXL-2.5G cross-connect matrix.

Figure 2-6 XC-VXL-2.5G Cross-Connect Matrix



2.5.1 XC-VXL-2.5G Card Functionality

The XC-VXL-2.5G card manages up to 192 bidirectional STM-1 cross-connects, 192 bidirectional E-3 or DS-3 cross-connects, or 1008 bidirectional E-1 cross-connects. The TCC2/TCC2P card assigns bandwidth to each slot on a per-STM-1 basis. The XC-VXL-2.5G card works with the TCC2/TCC2P card to maintain connections and set up cross-connects within the node. You can establish cross-connect and provisioning information through CTC.

Note Cisco does not support operating the ONS 15454 SDH with only one XC-VXL-2.5G card. Always operate in a redundant configuration. Install the XC-VXL-2.5G cards in Slots 8 and 10.

2.5.2 XC-VXL-2.5G Card-Level Indicators

Table 2-16 describes the two card-level LEDs on the XC-VXL-2.5G faceplate.

Table 2-16 XC-VXL-2.5G Card-Level Indicators

Card-Level LEDs	Definition
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. The FAIL LED is on during reset and flashes during the boot process. Replace the card if the red FAIL LED persists.
ACT/STBY LED Green (Active) Amber (Standby)	The ACT/STBY (Active/Standby) LED indicates whether the XC-VXL-2.5G is active and carrying traffic (green) or in standby mode to the active XC-VXL-2.5G card (amber).

2.6 XC-VXC-10G Card

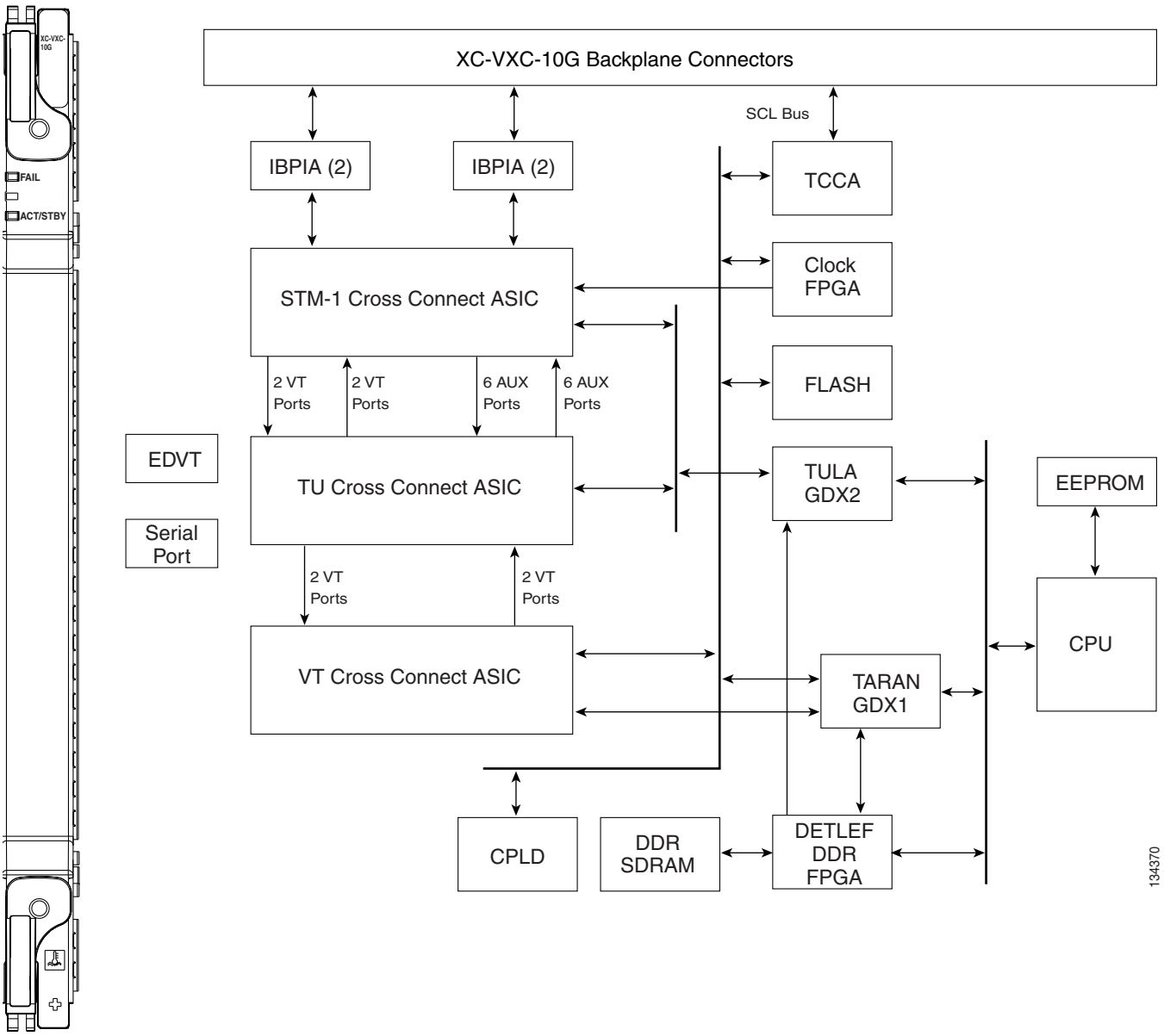
Note For XC-VXC-10G card specifications, see the "A.4.5 XC-XVC-10G Card Specifications" section on page A-12.

The XC-VXC-10G card establishes connections at the VC-4, VC-3, VC-12, and VC-11 levels. The XC-VXC-10G cards provides STM-64 capacity to Slots 5, 6, 12, and 13, and STM-16 capacity to Slots 1 to 4 and 14 to 17. Any VC-4 on any port can be connected to any other port, meaning that the VC-4 cross-connections are nonblocking. XC-VXC-10G supports LO circuits on SNCP with non intrusive monitoring.

The XC-VXC-10G card can be configured to support either VC-12 or VC-11 grooming, or mixed (VC-12 and VC-11) grooming.

Figure 2-7 shows the XC-VXC-10G faceplate and block diagram.

Figure 2-7 XC-VXC-10G Faceplate and Block Diagram



2.6.1 XC-VXC-10G Functionality

The XC-VXC-10G card manages up to 192 bidirectional VC-4 cross-connects, 192 VC-3 bidirectional cross-connects, 1008 VC-12 bidirectional cross-connects, or 1344 VC-11 bidirectional cross-connects. The TCC2/TCC2P card assigns bandwidth to each slot on a per-STM-1 basis.

The XC-VXC-10G card provides the following:

- 384 VC-4 bidirectional ports
- 192 VC-4 bidirectional cross-connects
- 384 VC-3 bidirectional ports

- 192 VC-3 bidirectional cross-connects
- 2016 VC-12 ports by means of 96 logical VC-3 ports
- 1008 VC-12 bidirectional cross-connects
- 2688 VC-11 ports by means of 96 logical VC-3 ports
- 1344 VC-11 bidirectional cross-connects
- Nonblocking operation at the VC-11 level
- VC-11, VC-12, VC-4/-4c/-8c/-16c/-64c cross-connects
- Grooming modes supported:
  - Full VC-12 grooming
  - Full VC-11 grooming
  - Mixed grooming (50%/50%): 1008 x 1008 VC-12/1344 x 1344 VC-11

Caution Do not operate the ONS 15454 with only one XC-VXC-10G card. Two cross-connect cards must always be installed.

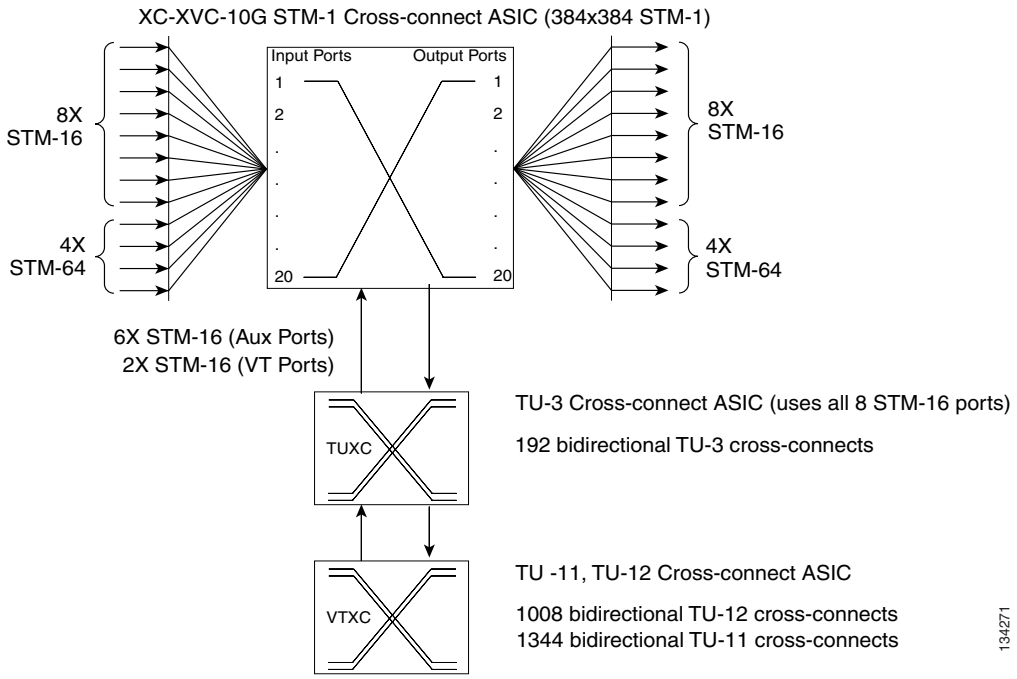
The XC-VXC-10G supports errorless side switches (switching from one XC-VXC-10G on one side of the shelf to the other XC-VXC-10G on the other side of the shelf) at the VC-4 circuit level when the switch is initiated through software and the shelf is equipped with TCC2/TCC2P cards.

Note Only the 15454_MRC-12, OC192SR1/STM64IO Short Reach, and OC192/STM64 Any Reach cards (the latter two cards are designated in CTC as STM64-XFP) support errorless side switches.

Note Errorless side switch for the XC-VXC-10G card is not supported at the lower circuit levels (VC-3 and VC-11/VC-12).

Figure 2-8 shows the XC-VXC-10G cross-connect matrix.

Figure 2-8 XC-VXC-10G Cross-Connect Matrix



2.6.2 XC-VXC-10G Card-Level Indicators

Table 2-17 describes the two card-level LEDs on the XC-VXC-10G faceplates.

Table 2-17 XC-VXC-10G Card-Level Indicators

Card-Level Indicators	Definition
Red FAIL LED	Indicates that the cards processor is not ready. This LED illuminates during reset. The FAIL LED flashes during the boot process. Replace the card if the red FAIL LED persists.
ACT/STBY LED Green (Active) Amber (Standby)	Indicates whether the XC-VXC-10G is active and carrying traffic (green), or in standby mode to the active XC-VXC-10G card (amber).

2.6.3 XC-VXC-10G Compatibility

The XC-VXC-10G card supports the same features as the XC-VXL-10G and XC-VXL-2.5G cards. The XC-VXC-10G card supports STM-64 operation.

If you are using Ethernet cards, the E1000-2-G or the E100T-G must be used when the XC-VXC-10G cross-connect card is in use. When upgrading from an XC-VXL-10G card to an XC-VXC-10G card, refer to the "Upgrade Cards and Spans" chapter in the *Cisco ONS 15454 SDH Procedure Guide* for more information See also the "2.1.2 Card Compatibility" section on page 2-2.

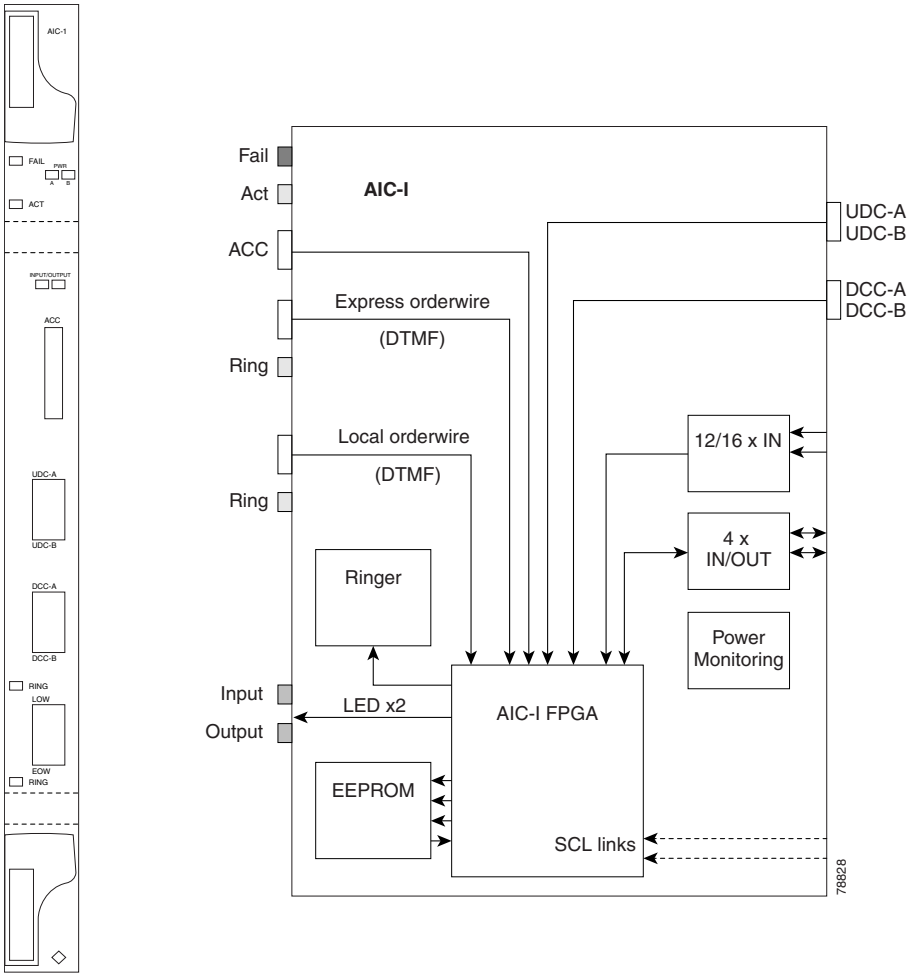
2.7 AIC-I Card

Note For AIC-I card specifications, see the "A.4.6 AIC-I Specifications" section on page A-12.

The optional AIC-I card provides customer-defined alarm inputs and outputs, user data channels (UDCs), and supports local and express orderwire. It provides 16 customer-defined input contacts and 4 customer-defined input/output contacts. It requires the MIC-A/P for connection to the alarm contacts.

Figure 2-9 shows the AIC-I card faceplate and a block diagram of the card.

Figure 2-9 AIC-I Faceplate and Block Diagram



2.7.1 AIC-I Card-Level Indicators

Table 2-18 describes the eight card-level LEDs on the AIC-I card.

Table 2-18 AIC-I Card-Level Indicators

Card-Level LEDs	Description
Red FAIL LED	Indicates that the card's processor is not ready. The FAIL LED is on during reset and flashes during the boot process. Replace the card if the red FAIL LED persists.
Green ACT LED	Indicates that the AIC-I card is provisioned for operation.
Green/Red PWR A LED	When green, indicates that a supply voltage within the specified range has been sensed on supply input A. It is red when the input voltage on supply input A is out of range.
Green/Red PWR B LED	When green, indicates that a supply voltage within the specified range has been sensed on supply input B. It is red when the input voltage on supply input B is out of range.
Amber INPUT LED	When amber, indicates that there is an alarm condition on at least one of the alarm inputs.
Amber OUTPUT LED	When amber, indicates that there is an alarm condition on at least one of the alarm outputs.
Green RING LED	The green RING LED on the local orderwire (LOW) side is flashing when a call is received on the LOW.
Green RING LED	The green RING LED on the express orderwire (EOW) side is flashing when a call is received on the EOW.

2.7.2 External Alarms and Controls

The optional AIC-I card provides input/output alarm contact closures. You can define up to 16 external alarm inputs and four external alarm inputs/outputs (user configurable). The physical connections are made using the MIC-A/P. The alarms are defined using CTC. For instructions, refer to the "Manage Alarms" chapter in the *Cisco ONS 15454 SDH Procedure Guide*.

LEDs on the front panel of the AIC-I indicate the status of the alarm contacts: one LED representing all the inputs and one LED representing all the outputs. External alarms (input contacts) are typically used for external sensors such as open doors, temperature sensors, flood sensors, and other environmental conditions. External controls (output contacts) are typically used to drive visual or audible devices such as bells and lights, but they can control other devices such as generators, heaters, and fans.

You can program each of the sixteen input alarm contacts separately. Choices include:

- Alarm on Closure or Alarm on Open
- Alarm severity of any level (Critical, Major, Minor, Not Alarmed, Not Reported)
- Service Affecting or Non-Service Affecting alarm-service level
- 63-character alarm description for CTC display in the alarm log

  You cannot assign the fan-tray abbreviation for the alarm; the abbreviation reflects the generic name of the input contacts. The alarm condition remains raised until the external input stops driving the contact or you unprovision the alarm input.

The output contacts can be provisioned to close on a trigger or to close manually. The trigger can be a local alarm severity threshold, a remote alarm severity, or a virtual wire, as follows:

- Local NE alarm severity: A hierarchy of Not Reported, Not Alarmed, Minor, Major, or Critical alarm severities that you set to cause output closure. For example, if the trigger is set to Minor, a Minor alarm or above is the trigger.
- Remote NE alarm severity: Same as the local NE alarm severity but applies to remote alarms only.
- Virtual wire entities: You can provision any environmental alarm input to raise a signal on any virtual wire on external outputs 1 through 4 when the alarm input is an event. You can provision a signal on any virtual wire as a trigger for an external control output.

You can also program the output alarm contacts (external controls) separately. In addition to provisionable triggers, you can manually force each external output contact to open or close. Manual operation takes precedence over any provisioned triggers that might be present.

2.7.3 Orderwire

Orderwire allows a craftsperson to plug a phone set into an ONS 15454 SDH and communicate with craftspeople working at other ONS 15454 SDH nodes or other facility equipment. The orderwire is a pulse code modulation (PCM) encoded voice channel that uses E1 or E2 bytes in the MSOH and in the regenerator section overhead.

The AIC-I allows simultaneous use of both local (RSOH signal) and express (MSOH signal) orderwire channels on an SDH ring or particular optics facility. Express orderwire also allows communication through regeneration sites when the regenerator is not a Cisco device.

You can provision orderwire functions with CTC similar to the current provisioning model for GCC channels. In CTC, you provision the orderwire communications network during ring turn-up so that all network elements (NEs) on the ring can communicate with one another. Orderwire terminations (that is, the optics facilities that receive and process the orderwire channels) are provisionable. Both express and local orderwire can be configured as on or off on a particular SDH facility. The ONS 15454 SDH supports up to four orderwire channel terminations per shelf. This allows linear, single ring, dual ring, and small hub-and-spoke configurations. Keep in mind that orderwire is not protected in ring topologies such as multiplex section-shared protection ring (MS-SPRing) and subnetwork connection protection (SNCP).

Caution Do not configure orderwire loops. Orderwire loops cause feedback that disables the orderwire channel.

The ONS 15454 SDH implementation of both local and express orderwire is broadcast in nature. The line acts as a party line. Anyone who picks up the orderwire channel can communicate with all other participants on the connected orderwire subnetwork. The local orderwire party line is separate from the express orderwire party line. Up to four STM-N facilities for each local and express orderwire are provisionable as orderwire paths.

Note The OC3 IR 4/STM1 SH 1310 card does not support the EOW channel.

The AIC-I supports selective dual tone multifrequency (DTMF) dialing for telephony connectivity, which causes specific or all ONS 15454 SDH AIC-Is on the orderwire subnetwork to “ring.” The ringer/buzzer resides on the AIC-I. There is also a “ring” LED that mimics the AIC-I ringer. It flashes when a call is received on the orderwire subnetwork. A party line call is initiated by pressing ***0000** on the DTMF pad. Individual dialing is initiated by pressing ***** and the individual four-digit number on the DTMF pad. The station number of the node is provisioned in CTC.

The orderwire ports are standard RJ-11 receptacles. The pins on the orderwire ports correspond to the tip and ring orderwire assignments.

Table 2-19 describes the orderwire pin assignments.

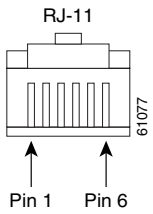
Table 2-19 Orderwire Pin Assignments

RJ-11 Pin Number	Description
1	Four-wire receive ring
2	Four-wire transmit tip
3	Two-wire ring
4	Two-wire tip
5	Four-wire transmit ring
6	Four-wire receive tip

When provisioning the orderwire subnetwork, make sure that an orderwire loop does not exist. Loops cause oscillation and an unusable orderwire channel.

Figure 2-10 shows the standard RJ-11 connectors used for orderwire ports. Use a shielded RJ-11 cable.

Figure 2-10 RJ-11 Cable Connector



2.7.4 Power Monitoring

The AIC-I card provides a power monitoring circuit that monitors the supply voltage of –48 VDC for presence, undervoltage, or overvoltage.

2.7.5 User Data Channel

The UDC features a dedicated data channel of 64 kbps (F1 byte) between two nodes in an ONS 15454 SDH network. Each AIC-I card provides two UDCs, UDC-A and UDC-B, through separate RJ-11 connectors on the front of the AIC-I. Each UDC can be routed to an individual optical interface in the ONS 15454 SDH system. For instructions, refer to the "Create Circuits and Low-Order Tunnels" chapter in the *Cisco ONS 15454 SDH Procedure Guide*.

The UDC ports are standard RJ-11 receptacles. Table 2-20 lists the UDC pin assignments.

Table 2-20 UDC Pin Assignments

RJ-11 Pin Number	Description
1	For future use
2	TXN
3	RXN
4	RXP
5	TXP
6	For future use

2.7.6 Data Communications Channel

The DCC features a dedicated data channel of 576 kbps (D4 to D12 bytes) between two nodes in an ONS 15454 SDH network. Each AIC-I card provides two DCCs, DCC-A and DCC-B, through separate RJ-45 connectors on the front of the AIC-I. Each DCC can be routed to an individual optical interface in the ONS 15454 SDH system.

Note DCC connections cannot be provisioned if DCC tunneling is configured on this span.

The DCC ports are standard RJ-45 receptacles. Table 2-21 describes the GCC pin assignments.

Table 2-21 GCC Pin Assignments

RJ-45 Pin Number	Description
1	TCLKP
2	TCLKN
3	TXP
4	TXN
5	RCLKP
6	RCLKN
7	RXP
8	RXN

Electrical Cards

This chapter describes the Cisco ONS 15454 SDH electrical card features and functions. It includes descriptions, hardware specifications, and block diagrams for each card. For installation and card turn-up procedures, refer to the *Cisco ONS 15454 SDH Procedure Guide*.

Chapter topics include:

- 3.1 Electrical Card Overview, page 3-1
- 3.2 E1-N-14 Card, page 3-4
- 3.3 E1-42 Card, page 3-6
- 3.4 E3-12 Card, page 3-8
- 3.5 DS3i-N-12 Card, page 3-10
- 3.6 STM1E-12 Card, page 3-12
- 3.7 FILLER Card, page 3-14
- 3.8 FMEC-E1 Card, page 3-15
- 3.9 FMEC-DS1/E1 Card, page 3-16
- 3.10 FMEC E1-120NP Card, page 3-18
- 3.11 FMEC E1-120PROA Card, page 3-21
- 3.12 FMEC E1-120PROB Card, page 3-23
- 3.13 E1-75/120 Impedance Conversion Panel, page 3-26
- 3.14 FMEC-E3/DS3 Card, page 3-28
- 3.15 FMEC STM1E 1:1 Card, page 3-29
- 3.16 BLANK-FMEC Faceplate, page 3-29
- 3.17 MIC-A/P FMEC, page 3-30
- 3.18 MIC-C/T/P FMEC, page 3-33

3.1 Electrical Card Overview

The card overview section summarizes card functions and compatibility.

Note Each card is marked with a symbol that corresponds to a slot (or slots) on the ONS 15454 shelf assembly. The cards are then installed into slots displaying the same symbols. See the "1.13.1 Card Slot Requirements" section on page 1-17 for a list of slots and symbols.

3.1.1 Card Summary

Table 3-1 shows available electrical cards for the ONS 15454 SDH.

Table 3-1 Electrical Cards

Card	Description	For Additional Information...
E1-N-14	Provides 14 E-1 ports and supports 1:1 and 1:N protection. It operates in Slots 1 to 5 and Slots 13 to 17.	See the "3.2 E1-N-14 Card" section on page 3-4.
E1-42	Provides 42 E-1 ports and supports 1:3 protection. It operates in Slots 1 to 4 and Slots 14 to 17.	See the "3.3 E1-42 Card" section on page 3-6.
E3-12	Provides 12 E-3 ports and supports 1:1 protection. It operates in Slots 1 to 5 and Slots 13 to 17.	See the "3.4 E3-12 Card" section on page 3-8.
DS3i-N-12	Provides 12 DS-3 ports and supports 1:1 and 1:N protection. It operates in Slots 1 to 5 and Slots 13 to 17.	See the "3.5 DS3i-N-12 Card" section on page 3-10.
STM1E-12	Provides 12 electrical STM-1 ports and supports 1:1 protection. It operates in Slots 1 to 4 and Slots 14 to 17.	See the "3.6 STM1E-12 Card" section on page 3-12.
FILLER	Assures fulfillment of EMC requirements in case of empty interface card slots.	See the "3.7 FILLER Card" section on page 3-14.
FMEC-E1	Provides electrical connection into the system for 14 pairs of 75-ohm 1.0/2.3 miniature coax connectors for unbalanced E-1 ports from the E1-N-14 card.	See the "3.8 FMEC-E1 Card" section on page 3-15.
FMEC-DS1/E1	Provides electrical connection into the system for 14 pairs of 120-ohm balanced E-1 ports from the E1-N-14 card. It uses high-density 37-pin DB connectors.	See the "3.9 FMEC-DS1/E1 Card" section on page 3-16.
FMEC E1-120NP	Provides electrical connection into the system for 42 pairs of 120-ohm balanced E-1 ports from the E1-42 card. It uses Molex 96-pin LFH connectors.	See the "3.10 FMEC E1-120NP Card" section on page 3-18.

Table 3-1 Electrical Cards (continued)

Card	Description	For Additional Information...
FMEC E1-120PROA	Provides electrical connection into the system for 42 pairs of 120-ohm balanced E-1 ports from the E1-42 card. It provides 1:3 protection from the A side (left side of the shelf). It occupies four slots, Slots 18 to 21. It uses Molex 96-pin LFH connectors.	See the "3.11 FMEC E1-120PROA Card" section on page 3-21.
FMEC E1-120PROB	Provides electrical connection into the system for 42 pairs of 120-ohm balanced E-1 ports from the E1-42 card. It provides 1:3 protection from the B side (right side of the shelf). It occupies four slots, Slots 26 to 29. It uses Molex 96-pin LFH connectors.	See the "3.12 FMEC E1-120PROB Card" section on page 3-23.
E1-75/120	Installed in the rack to provide a balanced 120-ohm connection for 42 E-1 interfaces that have a 75-ohm unbalanced connection. It uses Molex 96-pin LFH connectors and 1.0/2.3 miniature coax connectors.	See the "3.13 E1-75/120 Impedance Conversion Panel" section on page 3-26.
FMEC-E3/DS3	Provides electrical connection into the system for 12 pairs of 75-ohm 1.0/2.3 miniature coax connectors for unbalanced E-3 or DS-3 ports.	See the "3.14 FMEC-E3/DS3 Card" section on page 3-28.
FMEC STM1E 1:1	Provides electrical connection into the system for 2 x 12 pairs of 75-ohm 1.0/2.3 miniature coax connectors for unbalanced electrical STM-1 ports from two STM1E-12 cards in the case of 1:1 protected operation. The FMEC STM1E 1:1 card is two slots wide and is recognized in Slots 18–19, 20–21, 26–27, and 28–29.	See the "3.15 FMEC STM1E 1:1 Card" section on page 3-29.
BLANK-FMEC	Assures fulfillment of EMC requirements in case of empty FMEC slots.	See the "3.16 BLANK-FMEC Faceplate" section on page 3-29.
MIC-A/P	Provides connection for one of the two redundant inputs of system power and system connection for input and output alarms.	See the "3.17 MIC-A/P FMEC" section on page 3-30.
MIC-C/T/P	Provides connection for one of the two redundant inputs of system power and system connection for LAN ports and system timing input/output.	See the "3.18 MIC-C/T/P FMEC" section on page 3-33.

3.1.2 Card Compatibility

Table 3-2 lists the Cisco Transport Controller (CTC) software compatibility for each electrical card. See Table 2-4 on page 2-3 for a list of cross-connect cards that are compatible with each electrical card.

Note "Yes" indicates that this card is fully or partially supported by the indicated software release. Refer to the individual card reference section for more information about software limitations for this card.

Table 3-2 Electrical Card Software Release Compatibility

Electrical Card	R3.3	R3.4	R4.0	R4.1	R4.5	R4.6	R4.7	R5.0	R6.0	R7.0
E1-N-14	Yes	Yes	Yes	Yes	—	Yes	—	Yes	Yes	Yes
E1-42	—	—	Yes	—	—	Yes	—	Yes	Yes	Yes
E3-12	Yes	Yes	Yes	Yes	—	Yes	—	Yes	Yes	Yes
DS3i-N-12	Yes	Yes	Yes	Yes (4.1.2)	—	Yes	—	Yes	Yes	Yes
STM1E-12	—	—	—	—	—	—	—	Yes	Yes	Yes

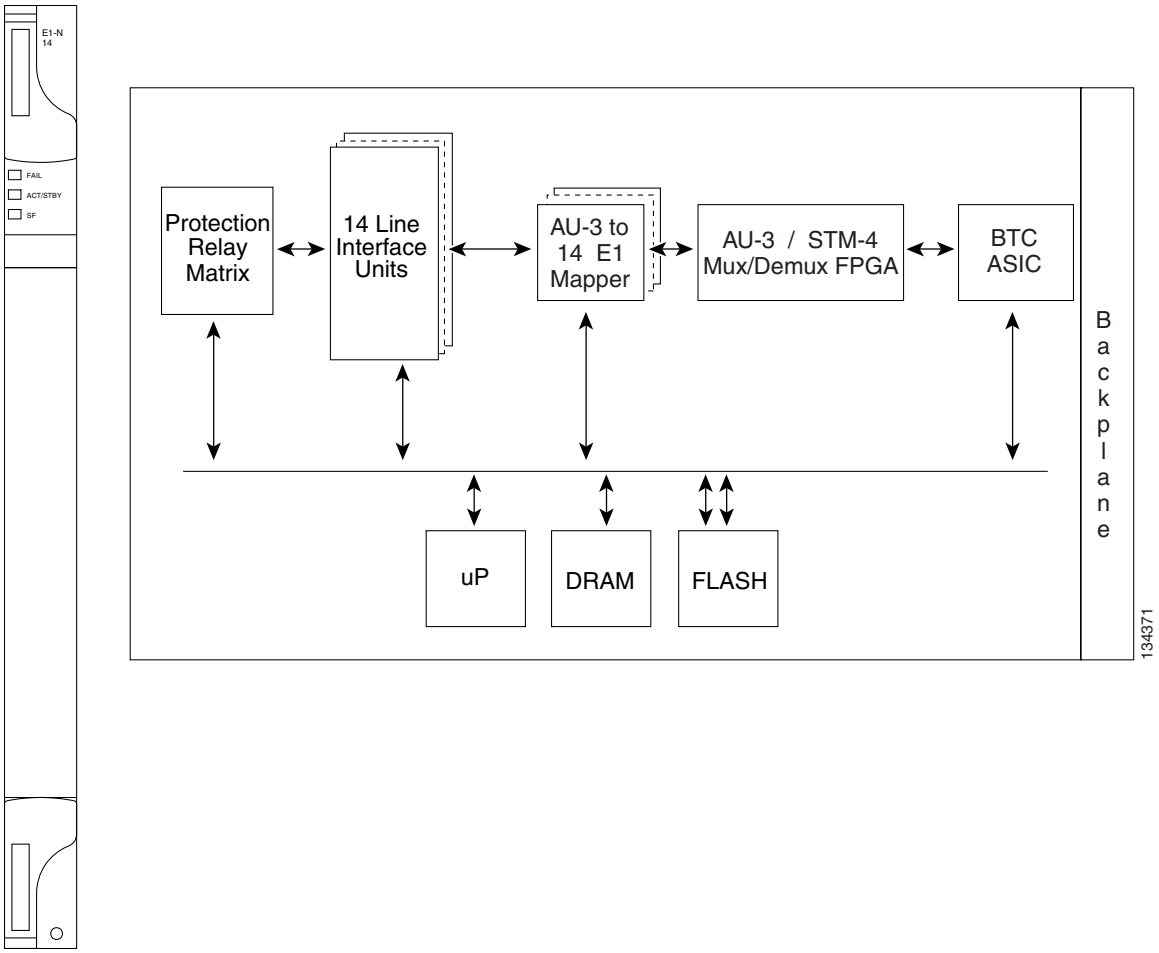
3.2 E1-N-14 Card

Note For E1-N-14 card specifications, see the "A.5.1 E1-N-14 Card Specifications" section on page A-14.

The 14-port ONS 15454 SDH E1-N-14 card provides 14 ITU-compliant, G.703 E-1 ports. Each port of the E1-N-14 card operates at 2.048 mbps over a 120-ohm, twisted-pair copper cable (with FMEC-E1) or over a 75-ohm unbalanced coaxial cable (with FMEC-E1). Figure 3-1 shows the E1-N-14 faceplate and block diagram.

Caution This interface can only be connected to Safety Extreme Low Voltage (SELV) circuits. The interface is not intended for connection to any Australian telecommunications network without the written consent of the network manager.

Figure 3-1 E1-N-14 Faceplate and Block Diagram



3.2.1 E1-N-14 Card Functionality

Each E1-N-14 port features ITU-T G.703 compliant outputs and inputs supporting cable losses of up to 6 dB at 1024 kHz. The E1-N-14 card supports 1:N (N <= 4) protection. You can also provision the E1-N-14 card to monitor line and frame errors in both directions.

The E1-N-14 card can function as a working or protect card in 1:1 or 1:N protection schemes. If you use the E1-N-14 card as a standard E-1 card in a 1:1 protection group, you can install the E1-N-14 card in Slots 1 to 6 and 12 to 17 of the ONS 15454 SDH. If you use the card's 1:N functionality, you must install an E1-N-14 card in Slot 3 (for bank A) or Slot 15 (for bank B).

You can group and map E1-N-14 card traffic in VC-12 as per ITU-T G.707 to any other card in an ONS 15454 SDH node. For performance-monitoring purposes, you can gather bidirectional E-1 frame-level information (for example, loss of frame, parity errors, or cyclic redundancy check [CRC] errors).

Note The lowest level cross-connect with the XC-VXL-10G card, XC-VXL-2.5G card, and XC-VXC-10G card is VC-12 (2.048 mbps).

3.2.2 E1-N-14 Card-Level Indicators

Table 3-3 describes the three E1-N-14 card faceplate LEDs.

Table 3-3 E1-N-14 Card-Level Indicators

Card-Level LEDs	Description
Red FAIL LED	Indicates that the card's processor is not ready. The FAIL LED is on during reset and flashes during the boot process. Replace the card if the FAIL LED persists in flashing.
ACT/STBY LED Green (Active) Amber (Standby)	Indicates that the E1-N-14 card is operational and ready to carry traffic (green) or that the card is in Standby mode (amber).
Amber SF LED	Indicates a signal failure or condition such as loss of signal (LOS), loss of frame (LOF), or a high bit error rate (BER) on one or more of the card's ports.

3.2.3 E1-N-14 Port-Level Indicators

You can obtain the status of the 14 E-1 ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

3.3 E1-42 Card

Note For E1-42 card specifications, see the "A.5.2 E1-42 Card Specifications" section on page A-15.

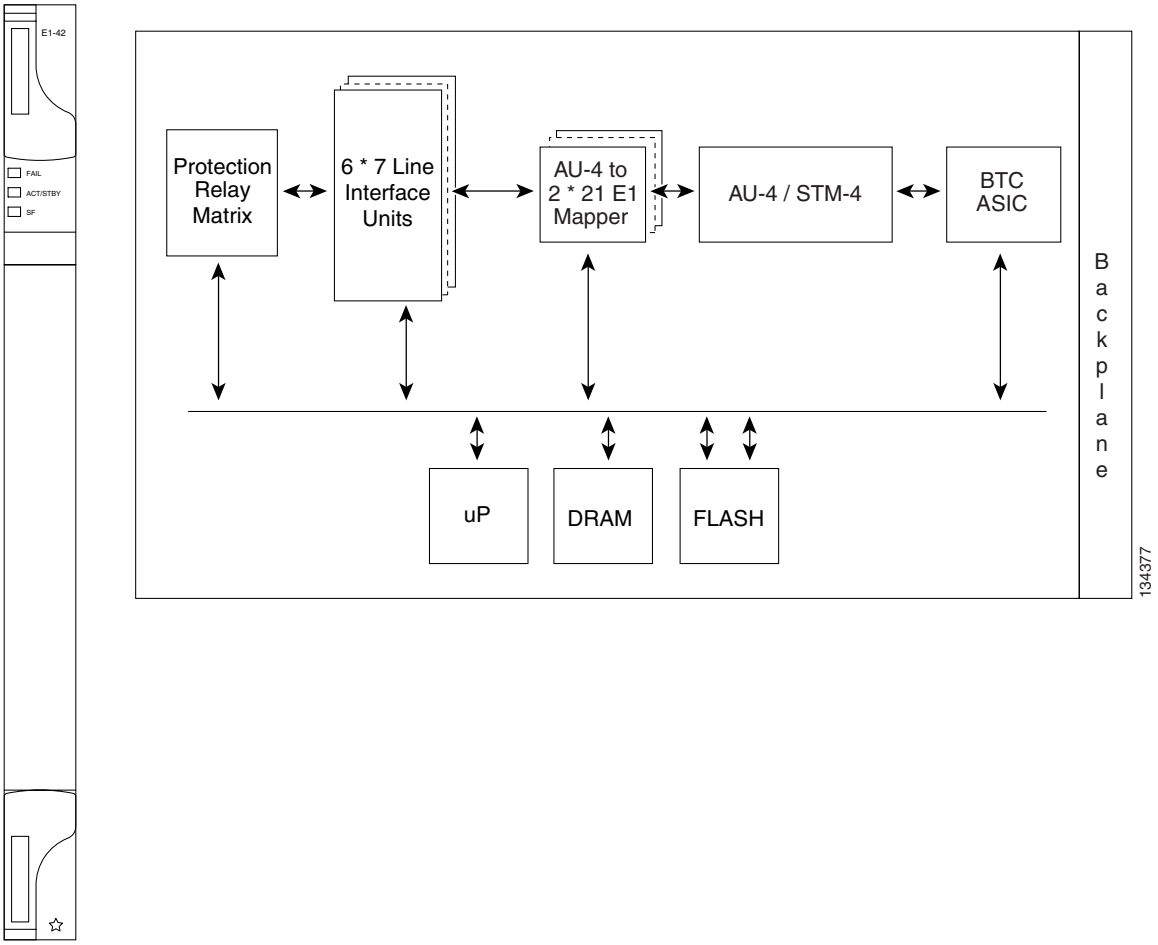
The 42-port ONS 15454 SDH E1-42 card provides 42 ITU-compliant, G.703 E-1 ports. Each port of the E1-42 card operates at 2.048 mbps over a 120-ohm, twisted-pair copper cable. Front mount electrical connection is done using the FMEC E1-120 NP card for unprotected operation, the FMEC E1-120PROA for 1:3 protection in the left side of the shelf, or the FMEC E1-120PROB for 1:3 protection in the right side of the shelf.

Caution This interface can only be connected to SELV circuits. The interface is not intended for connection to any Australian telecommunications network without the written consent of the network manager.

Note If you need 75-ohm unbalanced interfaces, you must additionally use the E1-75/120 conversion panel.

Figure 3-2 shows the E1-42 card faceplate and block diagram.

Figure 3-2 E1-42 Faceplate and Block Diagram



3.3.1 E1-42 Card Functionality

Each E1-42 port features ITU-T G.703 compliant outputs and inputs supporting cable losses of up to 6 dB at 1024 kHz. The E1-42 card supports 1:3 protection. You can also provision the E1-42 card to monitor line and frame errors in both directions.

The E1-42 card can function as a working or protect card in 1:3 protection schemes. If you use the E1-42 card as a standard E-1 card, you can install the E1-42 card in Slots 1 to 4 and 14 to 17 of the ONS 15454 SDH. If you use the card's 1:3 functionality, you must install an E1-42 card as the protect card in Slot 3 (for bank A) or in Slot 15 (for bank B).

You can group and map E1-42 card traffic in VC-12 as per ITU-T G.707 to any other card in an ONS 15454 SDH node. For performance-monitoring purposes, you can gather bidirectional E-1 frame-level information (for example, loss of frame, parity errors, or CRC errors).

Note The lowest level cross-connect with the XC-VXL-10G card, XC-VXL-2.5G card, and XC-VXC-10G card is VC-12 (2.048 mbps).

3.3.2 E1-42 Card-Level Indicators

Table 3-4 describes the three LEDs on the E1-42 card faceplate.

Table 3-4 E1-42 Card-Level Indicators

Card-Level LEDs	Description
Red FAIL LED	Indicates that the card's processor is not ready. The FAIL LED is on during reset and flashes during the boot process. Replace the card if the FAIL LED persists in flashing.
ACT/STBY LED Green (Active) Amber (Standby)	Indicates that the E1-42 card is operational and ready to carry traffic (green) or that the card is in Standby mode (amber).
Amber SF LED	Indicates a signal failure or condition such as LOS, LOF, or high BERs on one or more of the card's ports.

3.3.3 E1-42 Port-Level Indicators

You can obtain the status of the 42 E-1 ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

3.4 E3-12 Card

Note For E3-12 card specifications, see the "A.5.3 E3-12 Card Specifications" section on page A-16.

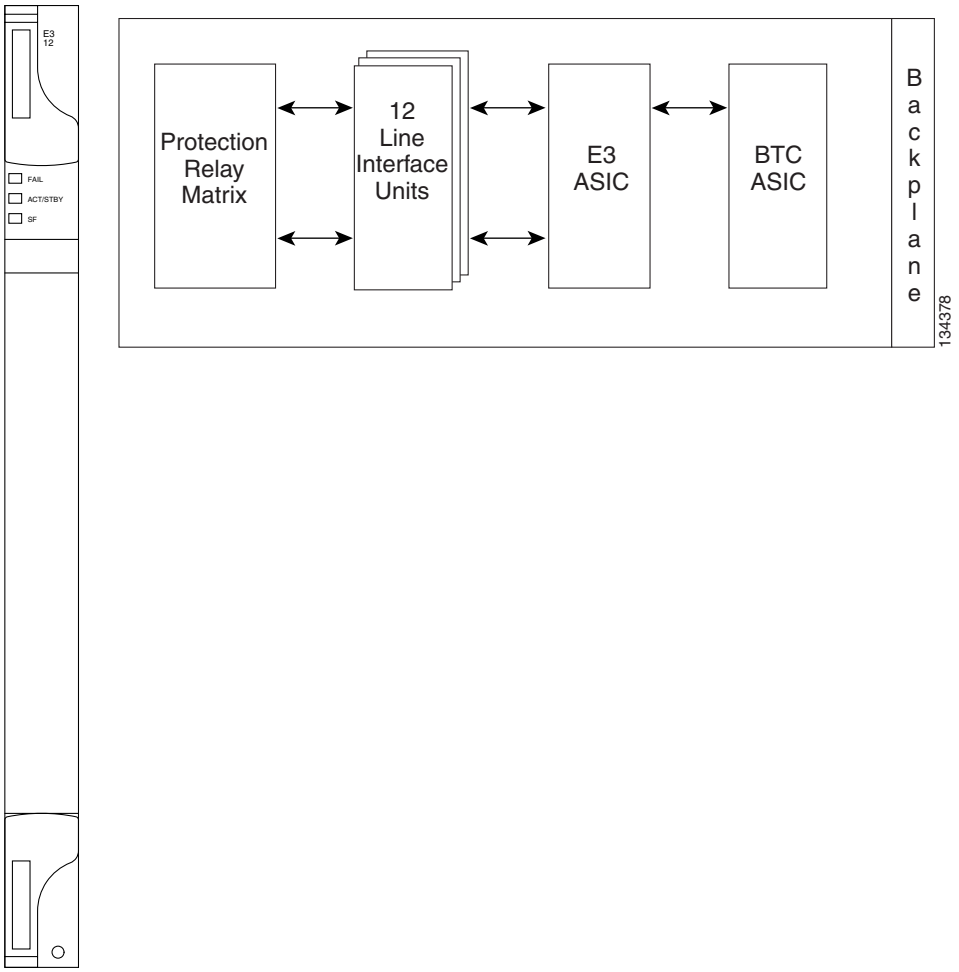
The 12-port ONS 15454 SDH E3-12 card provides 12 ITU-compliant, G.703 E-3 ports per card. Each interface operates at 34.368 mbps over a 75-ohm coaxial cable (with the FMEC-E3/DS3 card). The E3-12 card operates as a working or protect card in 1:1 protection schemes.

Caution This interface can only be connected to SELV circuits. The interface is not intended for connection to any Australian telecommunications network without the written consent of the network manager.

Note The E3-12 card can be deployed in a central office or a carrier's exchange.

Figure 3-3 shows the E3-12 card faceplate and block diagram.

Figure 3-3 E3-12 Card Faceplate and Block Diagram



3.4.1 E3-12 Card Functionality

You can install the E3-12 card in Slots 1 to 5 and 14 to 17 of the ONS 15454 SDH. Each E3-12 port features ITU-T G.703 compliant outputs supporting cable losses of up to 12 dB at 17184 kHz. The E3-12 card supports 1:1 protection.

Note The lowest level cross-connect with the XC-VXL-10G card, XC-VXL-2.5G card, and XC-VXC-10G card is VC-12 (2.048 mbps).

Note When a protection switch moves traffic from the E3-12 working/active card to the E3-12 protect/standby card, ports on the now active/standby card cannot be taken out of service. Lost traffic can result if you take a port out of service, even if the E3-12 active/standby card no longer carries traffic.

3.4.2 E3-12 Card-Level Indicators

Table 3-5 describes the three LEDs on the E3-12 card faceplate.

Table 3-5 E3-12 Card-Level Indicators

Card-Level LEDs	Description
Red FAIL LED	Indicates that the card's processor is not ready. The FAIL LED is on during reset and flashes during the boot process. Replace the card if the FAIL LED persists in flashing.
ACT/STBY LED Green (Active) Amber (Standby)	When the ACT/STBY LED is green, the E3-12 card is operational and ready to carry traffic. When the ACT/STBY LED is amber, the E3-12 card is operational and in Standby (protect) mode.
Amber SF LED	Indicates a signal failure or condition such as port LOS.

3.4.3 E3-12 Port-Level Indicators

You can find the status of the twelve E3-12 card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

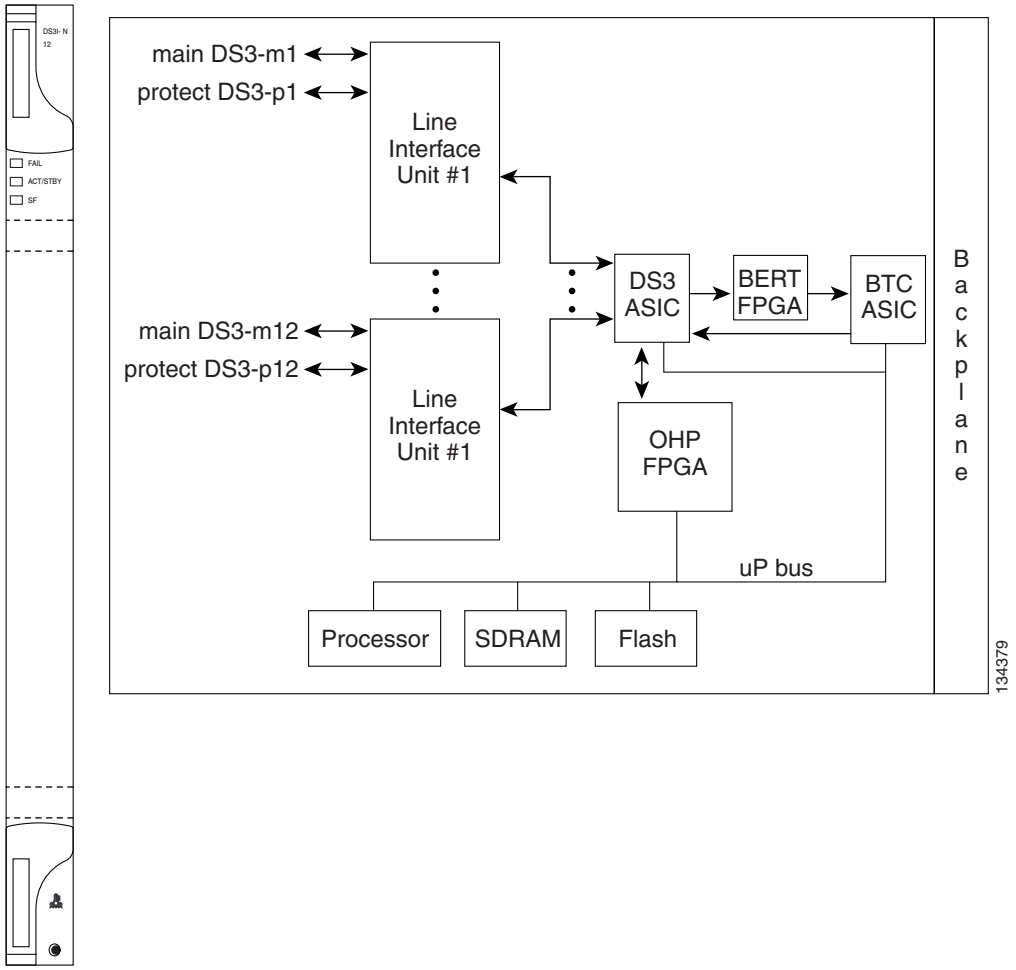
3.5 DS3i-N-12 Card

Note For DS3i-N-12 card specifications, see the "A.5.4 DS3i-N-12 Card Specifications" section on page A-17.

The 12-port ONS 15454 SDH DS3i-N-12 card provides 12 ITU-T G.703, ITU-T G.704, and Telcordia GR-499-CORE compliant DS-3 ports per card. Each port operates at 44.736 mbps over a 75-ohm coaxial cable (with the FMEC-E3/DS3 card). The DS3i-N-12 can operate as the protect card in a 1:N (N <= 4) DS-3 protection group. It has circuitry that allows it to protect up to four working DS3i-N-12 cards. In a 1:N protection group the DS3i-N-12 card must reside in either the Slot 3 or 15.

Figure 3-4 shows the DS3i-N-12 faceplate and block diagram.

Figure 3-4 DS3i-N-12 Faceplate and Block Diagram



3.5.1 DS3i-N-12 Card Functionality

The DS3i-N-12 can detect several different errored logic bits within a DS-3 frame. This function lets the ONS 15454 SDH identify a degrading DS-3 facility caused by upstream electronics (DS-3 Framer). In addition, DS-3 frame format autodetection and J1 path trace are supported. By monitoring additional overhead in the DS-3 frame, subtle network degradations can be detected.

The DS3i-n-12 can also aggregate DS3 and E1 traffic and transport it between SONET and SDH networks through AU4/STS 3 trunks, with the ability to add and drop DS3s to an STS3 trunk at intermediate nodes.

The following list summarizes the DS3i-N-12 card features:

- Provisionable framing format (M23, C-bit, or unframed)
- Autorecognition and provisioning of incoming framing
- VC-3 payload mapping as per ITU-T G.707
- Idle signal (“1100”) monitoring as per Telcordia GR-499-CORE
- P-bit monitoring

- C-bit parity monitoring
- X-bit monitoring
- M-bit monitoring
- F-bit monitoring
- Far-end block error (FEBE) monitoring
- Far-end alarm and control (FEAC) status and loop code detection
- Path trace byte support with TIM-P alarm generation

You can install the DS3i-N-12 card in Slots 1 to 5 and 13 to 17. Each DS3i-N-12 port features DS-N-level outputs supporting distances up to 137 m (450 feet). With FMEC-E3/DS3, the card supports 1.0/2.3 miniature coax nonbalanced connectors.

Note The lowest level cross-connect with the XC-VXL-10G card, XC-VXL-2.5G card, and XC-VXC-10G card is VC-12 (2.048 mbps).

3.5.2 DS3i-N-12 Card-Level Indicators

Table 3-6 describes the three LEDs on the DS3i-N-12 card faceplate.

Table 3-6 DS3i-N-12 Card-Level Indicators

Card-Level LEDs	Description
Red FAIL LED	Indicates that the card's processor is not ready. The FAIL LED is on during reset and flashes during the boot process. Replace the card if the red FAIL LED persists in flashing.
ACT/STBY LED Green (Active) Amber (Standby)	When the ACT/STBY LED is green, the DS3i-N-12 card is operational and ready to carry traffic. When the ACT/STBY LED is amber, the DS3i-N-12 card is operational and in Standby (protect) mode.
Amber SF LED	Indicates a signal failure or condition such as LOS or LOF on one or more of the card's ports.

3.5.3 DS3i-N-12 Port-Level Indicators

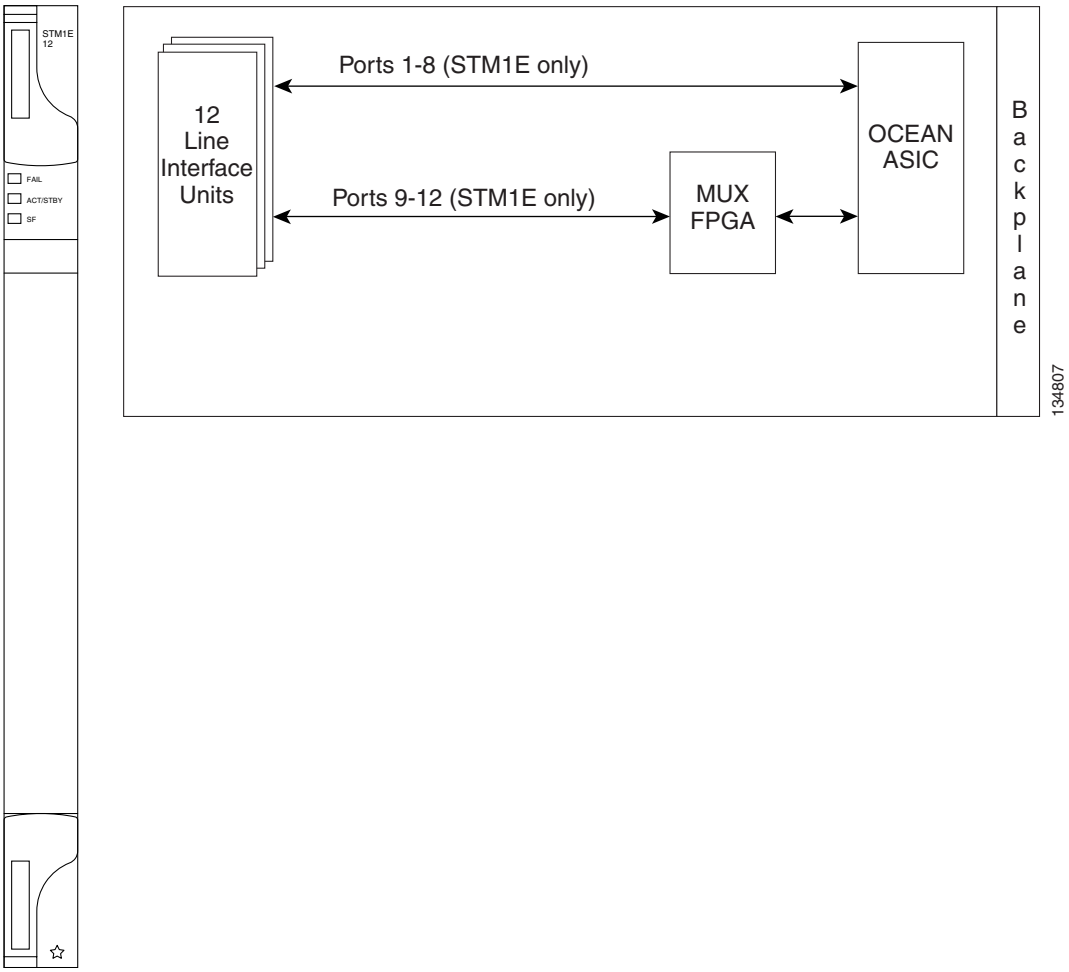
You can find the status of the DS3i-N-12 card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

3.6 STM1E-12 Card

Note For STM1E-12 card specifications, see the "A.5.5 STM1E-12 Card Specifications" section on page A-18.

The 12-port ONS 15454 SDH STM1E-12 card provides 12 ITU-compliant, G.703 STM-1 ports per card. Each interface operates at 155.52 mbps for STM-1 over a 75-ohm coaxial cable (with the FMEC STM1E 1:1 card). The STM1E-12 card operates as a working or protect card in 1:1 protection schemes. Figure 3-5 shows the STM1E-12 faceplate and block diagram.

Figure 3-5 STM1E-12 Faceplate and Block Diagram



3.6.1 STM 1E-12 Card Functionality

You can install the STM1E-12 card in Slots 1 to 4 and 14 to 17 of the ONS 15454 SDH. Each STM1E-12 port features ITU-T G.703 compliant outputs supporting cable losses of up to 12.7 dB at 78 MHz. The STM1E-12 card supports no protection and 1:1 protection. In both cases, the FMEC STM1E 1:1 card is used. Up to two unprotected active STM1E-12 cards use the same FMEC STM1E 1:1 card, and one active STM1E-12 card and one protect STM1E-12 card use the same FMEC STM1E 1:1 card.

Note When a protection switch moves traffic from the STM1E-12 working/active card to the STM1E-12 protect/standby card, ports on the now active/standby card cannot be taken out of service. Lost traffic can result if you take a port out of service, even if the STM1E-12 active/standby card no longer carries traffic.

Note Use an external clock when doing service disruption time measurements on the STM1E-12.

3.6.2 STM1E-12 Card-Level Indicators

Table 3-7 describes the three LEDs on the STM1E-12 card faceplate.

Table 3-7 STM1E-12 Card-Level Indicators

Card-Level LEDs	Description
Red FAIL LED	Indicates that the card's processor is not ready. The FAIL LED is on during reset and flashes during the boot process. Replace the card if the FAIL LED persists in flashing.
ACT/STBY LED Green (Active) Amber (Standby)	When the ACT/STBY LED is green, the STM1E-12 card is operational and ready to carry traffic. When the ACT/STBY LED is amber, the STM1E-12 card is operational and in Standby (protect) mode.
Amber SF LED	Indicates a signal failure or condition such as port LOS.

3.6.3 STM1E-12 Port-Level Indicators

You can find the status of the 12 STM1E-12 card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

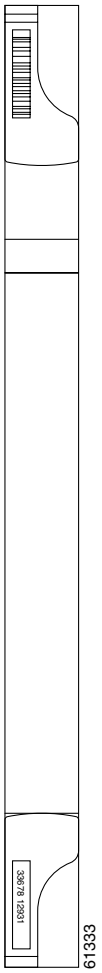
3.7 FILLER Card

Note For FILLER card specifications, see the "A.5.6 FILLER Card" section on page A-19.

The FILLER card provides EMC emission control for empty multiservice card slots. It also provides a way to close off the subrack front area, thus allowing air flow and convection to be maintained through the subrack. Figure 3-6 shows the FILLER card faceplate.

Caution You must install the FILLER card in every empty interface card slot to maintain EMC requirements of the system and proper air flow.

Figure 3-6 FILLER Faceplate



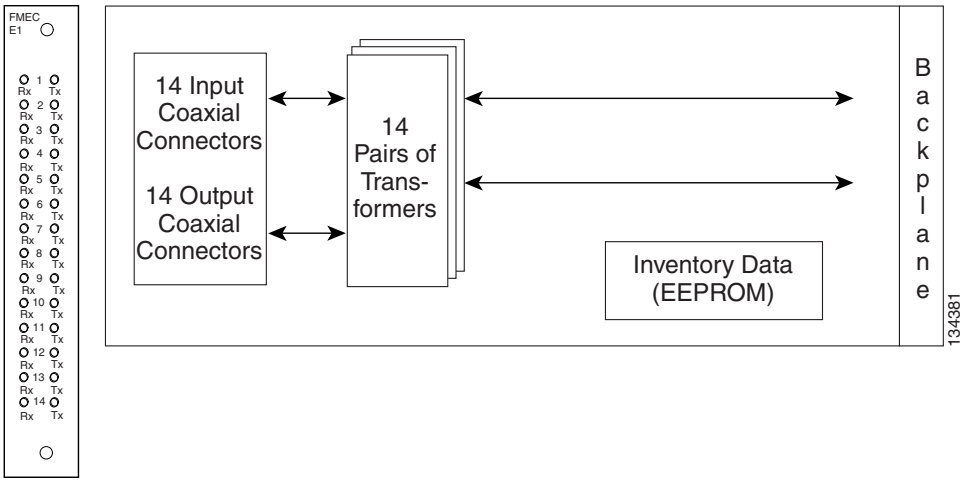
3.8 FMEC-E1 Card

Note For FMEC-E1 specifications, see the "A.5.7 FMEC-E1 Specifications" section on page A-19.

The ONS 15454 SDH FMEC-E1 card provides front mount electrical connection for 14 ITU-compliant, G.703 E-1 ports. With the FMEC-E1 card, each E1-N-14 port operates at 2.048 mbps over a 75-ohm unbalanced coaxial 1.0/2.3 miniature coax connector. Figure 3-7 shows the FMEC-E1 card faceplate and block diagram.

Caution This interface can only be connected to SELV circuits. The interface is not intended for connection to any Australian telecommunications network without the written consent of the network manager.

Figure 3-7 FMEC-E1 Faceplate and Block Diagram



You can install the FMEC-E1 card in any Electrical Facility Connection Assembly (EFCA) slot from Slot 18 to 22 or Slot 25 to 29 of the ONS 15454 SDH. Each FMEC-E1 card port features E1-level inputs and outputs supporting cable losses of up to 6 dB at 1024 kHz.

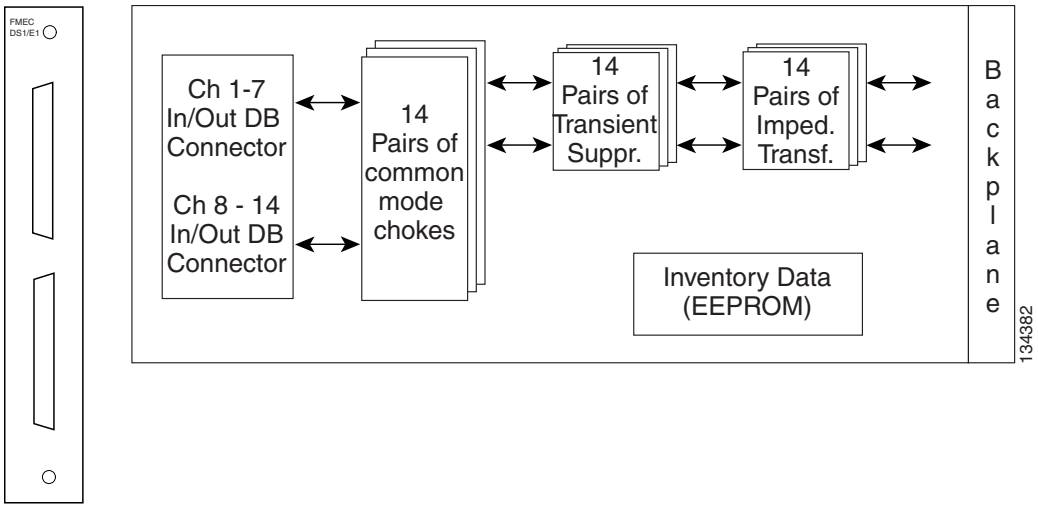
3.9 FMEC-DS1/E1 Card

Note For FMEC-DS1/E1 specifications, see the "A.5.8 FMEC-DS1/E1 Specifications" section on page A-20.

The ONS 15454 SDH FMEC-DS1/E1 card provides front mount electrical connection for 14 ITU-compliant, G.703 E-1 ports. With the FMEC-DS1/E1 card, each E1-N-14 port operates at 2.048 mbps over a 120-ohm balanced cable via two 37-pin DB connectors. Figure 3-8 shows the FMEC-DS1/E1 card faceplate and block diagram.

Caution This interface can only be connected to SELV circuits. The interface is not intended for connection to any Australian telecommunications network without the written consent of the network manager.

Figure 3-8 FMEC-DS1/E1 Faceplate and Block Diagram



You can install the FMEC-DS1/E1 card in any EFCA slot from Slot 18 to 22 or Slot 25 to 29 of the ONS 15454 SDH. Each FMEC-DS1/E1 card interface features E1-level inputs and outputs supporting cable losses of up to 6 dB at 1024 kHz.

Use Table 3-8 to make the connection from the E-1 37-pin DB connector for Ports 1 to 7 to the external balanced 120-ohm E-1 interfaces.

Table 3-8 E-1 Interface Pinouts on the FMEC-DS1/E1 Card Ports 1 to 7

Pin No.	Signal Name	Pin No.	Signal Name
1	GND	20	RX 7 P
2	TX 7 P	21	RX 7 N
3	TX 7 N	22	GND
4	TX 6 P	23	RX 6 P
5	TX 6 N	24	RX 6 N
6	GND	25	RX 5 P
7	TX 5 P	26	RX 5 N
8	TX 5 N	27	GND
9	TX 4 P	28	RX 4 P
10	TX 4 N	29	RX 4 N
11	GND	30	RX 3 P
12	TX 3 P	31	RX 3 N
13	TX 3 N	32	GND
14	TX 2 P	33	RX 2 P
15	TX 2 N	34	RX 2 N
16	GND	35	RX 1 P
17	TX 1 P	36	RX 1 N

Table 3-8 E-1 Interface Pinouts on the FMEC-DS1/E1 Card Ports 1 to 7 (continued)

Pin No.	Signal Name	Pin No.	Signal Name
18	TX 1 N	37	GND
19	GND	—	—

Use Table 3-9 to make the connection from the E-1 37-pin DB connector for Ports 8 to 14 to the external balanced 120-ohm E-1 interfaces.

Table 3-9 E-1 Interface Pinouts on the FMEC-DS1/E1 Card Ports 8 to 14

Pin No.	Signal Name	Pin No.	Signal Name
1	GND	20	RX 14 P
2	TX 14 P	21	RX 14 N
3	TX 14 N	22	GND
4	TX 13 P	23	RX 13 P
5	TX 13 N	24	RX 13 N
6	GND	25	RX 12 P
7	TX 12 P	26	RX 12 N
8	TX 12 N	27	GND
9	TX 11 P	28	RX 11 P
10	TX 11 N	29	RX 11 N
11	GND	30	RX 10 P
12	TX 10 P	31	RX 10 N
13	TX 10 N	32	GND
14	TX 9 P	33	RX 9 P
15	TX 9 N	34	RX 9 N
16	GND	35	RX 8 P
17	TX 8 P	36	RX 8 N
18	TX 8 N	37	GND
19	GND	—	—

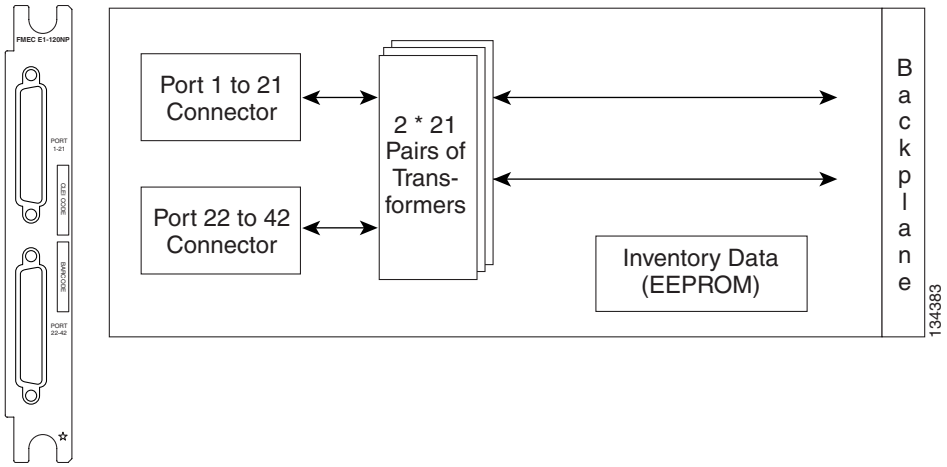
3.10 FMEC E1-120NP Card

Note For FMEC E1-120NP specifications, see the "A.5.9 FMEC E1-120NP Specifications" section on page A-21.

The ONS 15454 SDH FMEC E1-120NP card provides front mount electrical connection for 42 ITU-compliant, G.703 E-1 ports. With the FMEC E1-120NP card, each E1-42 port operates at 2.048 mbps over a 120-ohm balanced interface. Twenty-one interfaces are led through one common Molex 96-pin LFH connector. Figure 3-9 shows the FMEC E1-120NP faceplate and block diagram.

Caution This interface can only be connected to SELV circuits. The interface is not intended for connection to any Australian telecommunications network without the written consent of the network manager.

Figure 3-9 FMEC E1-120NP Faceplate and Block Diagram



You can install the FMEC E1-120NP card in any EFCA slot from Slot 18 to 22 or Slot 25 to 29 of the ONS 15454 SDH. Each FMEC E1-120NP card port features E1-level inputs and outputs supporting cable losses of up to 6 dB at 1024 kHz.

Use Table 3-10 to make the connection from the E-1 96-pin connector for Ports 1 to 21 to the external balanced 120-ohm E-1 interfaces.

Table 3-10 E-1 Interface Pinouts on the FMEC E1-120NP Card Ports 1 to 21

Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name
1	TX 11 N	25	RX 11 N	49	TX 21 N	73	RX 21 N
2	TX 11 P	26	RX 11 P	50	TX 21 P	74	RX 21 P
3	TX 10 N	27	RX 10 N	51	TX 20 N	75	RX 20 N
4	TX 10 P	28	RX 10 P	52	TX 20 P	76	RX 20 P
5	TX 9 N	29	RX 9 N	53	TX 19 N	77	RX 19 N
6	TX 9 P	30	RX 9 P	54	TX 19 P	78	RX 19 P
7	TX 8 N	31	RX 8 N	55	TX 18 N	79	RX 18 N
8	TX 8 P	32	RX 8 P	56	TX 18 P	80	RX 18 P
9	TX 7 N	33	RX 7 N	57	TX 17 N	81	RX 17 N
10	TX 7 P	34	RX 7 P	58	TX 17 P	82	RX 17 P
11	TX 6 N	35	RX 6 N	59	TX 16 N	83	RX 16 N
12	TX 6 P	36	RX 6 P	60	TX 16 P	84	RX 16 P
13	TX 5 N	37	RX 5 N	61	TX 15 N	85	RX 15 N
14	TX 5 P	38	RX 5 P	62	TX 15 P	86	RX 15 P

Table 3-10 E-1 Interface Pinouts on the FMEC E1-120NP Card Ports 1 to 21 (continued)

Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name
15	TX 4 N	39	RX 4 N	63	TX 14 N	87	RX 14 N
16	TX 4 P	40	RX 4 P	64	TX 14 P	88	RX 14 P
17	TX 3 N	41	RX 3 N	65	TX 13 N	89	RX 13 N
18	TX 3 P	42	RX 3 P	66	TX 13 P	90	RX 13 P
19	TX 2 N	43	RX 2 N	67	TX 12 N	91	RX 12 N
20	TX 2 P	44	RX 2 P	68	TX 12 P	92	RX 12 P
21	TX 1 N	45	RX 1 N	69	NC	93	NC
22	TX 1 P	46	RX 1 P	70	NC	94	NC
23	NC	47	NC	71	NC	95	NC
24	NC	48	NC	72	NC	96	NC

Use Table 3-11 to make the connection from the E-1 96-pin connector for Ports 22 to 42 to the external balanced 120-ohm E-1 interfaces.

Table 3-11 E-1 Interface Pinouts on the FMEC E1-120NP Card Ports 22 to 42

Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name
1	TX 32 N	25	RX 32 N	49	TX 42 N	73	RX 42 N
2	TX 32 P	26	RX 32 P	50	TX 42 P	74	RX 42 P
3	TX 31 N	27	RX 31 N	51	TX 41 N	75	RX 41 N
4	TX 31 P	28	RX 31 P	52	TX 41 P	76	RX 41 P
5	TX 30 N	29	RX 30 N	53	TX 40 N	77	RX 40 N
6	TX 30 P	30	RX 30 P	54	TX 40 P	78	RX 40 P
7	TX 29 N	31	RX 29 N	55	TX 39 N	79	RX 39 N
8	TX 29 P	32	RX 29 P	56	TX 39 P	80	RX 39 P
9	TX 28 N	33	RX 28 N	57	TX 38 N	81	RX 38 N
10	TX 28 P	34	RX 28 P	58	TX 38 P	82	RX 38 P
11	TX 27 N	35	RX 27 N	59	TX 37 N	83	RX 37 N
12	TX 27 P	36	RX 27 P	60	TX 37 P	84	RX 37 P
13	TX 26 N	37	RX 26 N	61	TX 36 N	85	RX 36 N
14	TX 26 P	38	RX 26 P	62	TX 36 P	86	RX 36 P
15	TX 25 N	39	RX 25 N	63	TX 35 N	87	RX 35 N
16	TX 25 P	40	RX 25 P	64	TX 35 P	88	RX 35 P
17	TX 24 N	41	RX 24 N	65	TX 34 N	89	RX 34 N
18	TX 24 P	42	RX 24 P	66	TX 34 P	90	RX 34 P
19	TX 23 N	43	RX 23 N	67	TX 33 N	91	RX 33 N

Table 3-11 E-1 Interface Pinouts on the FMEC E1-120NP Card Ports 22 to 42 (continued)

Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name
20	TX 23 P	44	RX 23 P	68	TX 33 P	92	RX 33 P
21	TX 22 N	45	RX 22 N	69	NC	93	NC
22	TX 22 P	46	RX 22 P	70	NC	94	NC
23	NC	47	NC	71	NC	95	NC
24	NC	48	NC	72	NC	96	NC

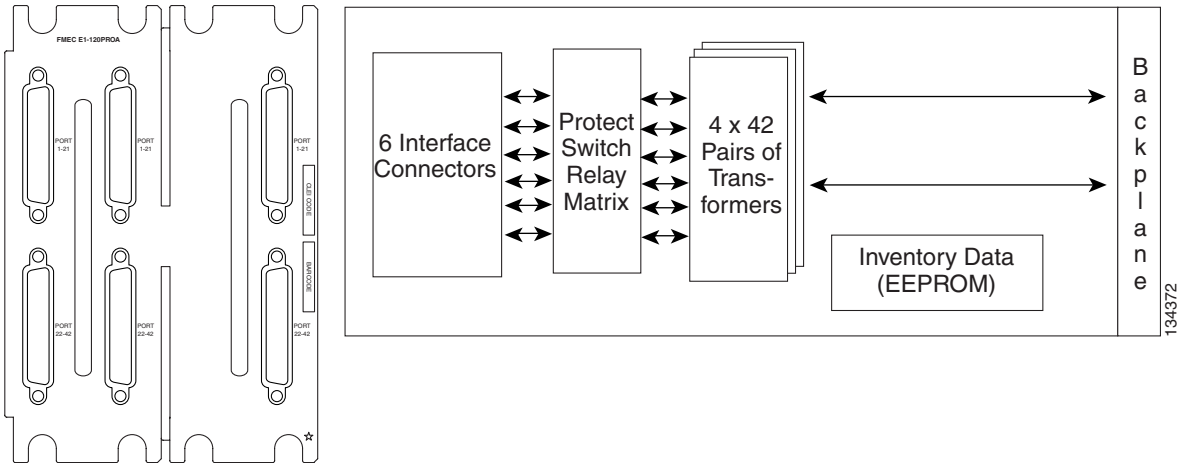
3.11 FMEC E1-120PROA Card

Note For FMEC E1-120PROA specifications, see the "A.5.10 FMEC E1-120PROA Specifications" section on page A-21.

The ONS 15454 SDH FMEC E1-120PROA card provides front mount electrical connection for 126 ITU compliant, G.703 E-1 ports. With the FMEC E1-120PROA card, each E1-42 port operates at 2.048 mbps over a 120-ohm balanced interface. Each Molex 96-pin LFH connector supports 21 E1 interfaces. Figure 3-10 shows the FMEC E1-120PROA faceplate and block diagram.

Caution This interface can only be connected to SELV circuits. The interface is not intended for connection to any Australian telecommunications network without the written consent of the network manager.

Figure 3-10 FMEC E1-120PROA Faceplate and Block Diagram



You can install the FMEC E1-120PROA card in the EFCA in the four far-left slots (Slots 18 to 21) on the ONS 15454 SDH. Each FMEC E1-120PROA card port features E1-level inputs and outputs supporting cable losses of up to 6 dB at 1024 kHz.

Use Table 3-12 to make the connection from the E-1 96-pin connector for Ports 1 to 21 to the external balanced 120-ohm E-1 interfaces.

Table 3-12 E-1 Interface Pinouts on the FMEC E1-120PROA Card Ports 1 to 21

Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name
1	TX 11 N	25	RX 11 N	49	TX 21 N	73	RX 21 N
2	TX 11 P	26	RX 11 P	50	TX 21 P	74	RX 21 P
3	TX 10 N	27	RX 10 N	51	TX 20 N	75	RX 20 N
4	TX 10 P	28	RX 10 P	52	TX 20 P	76	RX 20 P
5	TX 9 N	29	RX 9 N	53	TX 19 N	77	RX 19 N
6	TX 9 P	30	RX 9 P	54	TX 19 P	78	RX 19 P
7	TX 8 N	31	RX 8 N	55	TX 18 N	79	RX 18 N
8	TX 8 P	32	RX 8 P	56	TX 18 P	80	RX 18 P
9	TX 7 N	33	RX 7 N	57	TX 17 N	81	RX 17 N
10	TX 7 P	34	RX 7 P	58	TX 17 P	82	RX 17 P
11	TX 6 N	35	RX 6 N	59	TX 16 N	83	RX 16 N
12	TX 6 P	36	RX 6 P	60	TX 16 P	84	RX 16 P
13	TX 5 N	37	RX 5 N	61	TX 15 N	85	RX 15 N
14	TX 5 P	38	RX 5 P	62	TX 15 P	86	RX 15 P
15	TX 4 N	39	RX 4 N	63	TX 14 N	87	RX 14 N
16	TX 4 P	40	RX 4 P	64	TX 14 P	88	RX 14 P
17	TX 3 N	41	RX 3 N	65	TX 13 N	89	RX 13 N
18	TX 3 P	42	RX 3 P	66	TX 13 P	90	RX 13 P
19	TX 2 N	43	RX 2 N	67	TX 12 N	91	RX 12 N
20	TX 2 P	44	RX 2 P	68	TX 12 P	92	RX 12 P
21	TX 1 N	45	RX 1 N	69	NC	93	NC
22	TX 1 P	46	RX 1 P	70	NC	94	NC
23	NC	47	NC	71	NC	95	NC
24	NC	48	NC	72	NC	96	NC

Use Table 3-13 to make the connection from the E-1 96-pin connector for Ports 22 to 42 to the external balanced 120-ohm E-1 interfaces.

Table 3-13 E-1 Interface Pinouts on the FMEC E1-120PROA Card Ports 22 to 42

Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name
1	TX 32 N	25	RX 32 N	49	TX 42 N	73	RX 42 N
2	TX 32 P	26	RX 32 P	50	TX 42 P	74	RX 42 P
3	TX 31 N	27	RX 31 N	51	TX 41 N	75	RX 41 N
4	TX 31 P	28	RX 31 P	52	TX 41 P	76	RX 41 P
5	TX 30 N	29	RX 30 N	53	TX 40 N	77	RX 40 N

Table 3-13 E-1 Interface Pinouts on the FMEC E1-120PROA Card Ports 22 to 42 (continued)

Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name
6	TX 30 P	30	RX 30 P	54	TX 40 P	78	RX 40 P
7	TX 29 N	31	RX 29 N	55	TX 39 N	79	RX 39 N
8	TX 29 P	32	RX 29 P	56	TX 39 P	80	RX 39 P
9	TX 28 N	33	RX 28 N	57	TX 38 N	81	RX 38 N
10	TX 28 P	34	RX 28 P	58	TX 38 P	82	RX 38 P
11	TX 27 N	35	RX 27 N	59	TX 37 N	83	RX 37 N
12	TX 27 P	36	RX 27 P	60	TX 37 P	84	RX 37 P
13	TX 26 N	37	RX 26 N	61	TX 36 N	85	RX 36 N
14	TX 26 P	38	RX 26 P	62	TX 36 P	86	RX 36 P
15	TX 25 N	39	RX 25 N	63	TX 35 N	87	RX 35 N
16	TX 25 P	40	RX 25 P	64	TX 35 P	88	RX 35 P
17	TX 24 N	41	RX 24 N	65	TX 34 N	89	RX 34 N
18	TX 24 P	42	RX 24 P	66	TX 34 P	90	RX 34 P
19	TX 23 N	43	RX 23 N	67	TX 33 N	91	RX 33 N
20	TX 23 P	44	RX 23 P	68	TX 33 P	92	RX 33 P
21	TX 22 N	45	RX 22 N	69	NC	93	NC
22	TX 22 P	46	RX 22 P	70	NC	94	NC
23	NC	47	NC	71	NC	95	NC
24	NC	48	NC	72	NC	96	NC

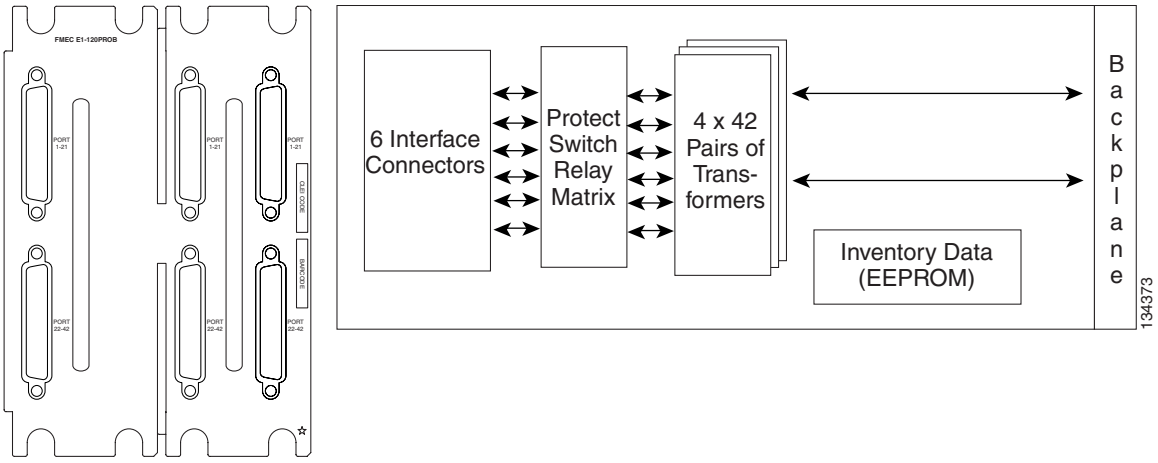
3.12 FMEC E1-120PROB Card

Note For FMEC E1-120PROB specifications, see the "A.5.11 FMEC E1-120PROB Specifications" section on page A-22.

The ONS 15454 SDH FMEC E1-120PROB card provides front mount electrical connection for 126 ITU-compliant, G.703 E-1 ports. With the FMEC E1-120PROB card, each E1-42 port operates at 2.048 mbps over a 120-ohm balanced interface. Each Molex 96-pin LFH connector supports 21 E-1 interfaces. Figure 3-11 shows the FMEC E1-120PROB faceplate and block diagram.

Caution This interface can only be connected to SELV circuits. The interface is not intended for connection to any Australian telecommunications network without the written consent of the network manager.

Figure 3-11 FMEC E1-120PROB Faceplate and Block Diagram



You can install the FMEC E1-120PROB card in EFCA Slots 26 to 29 of the ONS 15454 SDH. Each FMEC E1-120PROB card port features E1-level inputs and outputs supporting cable losses of up to 6 dB at 1024 kHz.

Use Table 3-14 to make the connection from the E-1 96-pin connector for Ports 1 to 21 to the external balanced 120-ohm E-1 interfaces.

Table 3-14 E-1 Interface Pinouts on the FMEC E1-120PROB Card Ports 1 to 21

Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name
1	TX 11 N	25	RX 11 N	49	TX 21 N	73	RX 21 N
2	TX 11 P	26	RX 11 P	50	TX 21 P	74	RX 21 P
3	TX 10 N	27	RX 10 N	51	TX 20 N	75	RX 20 N
4	TX 10 P	28	RX 10 P	52	TX 20 P	76	RX 20 P
5	TX 9 N	29	RX 9 N	53	TX 19 N	77	RX 19 N
6	TX 9 P	30	RX 9 P	54	TX 19 P	78	RX 19 P
7	TX 8 N	31	RX 8 N	55	TX 18 N	79	RX 18 N
8	TX 8 P	32	RX 8 P	56	TX 18 P	80	RX 18 P
9	TX 7 N	33	RX 7 N	57	TX 17 N	81	RX 17 N
10	TX 7 P	34	RX 7 P	58	TX 17 P	82	RX 17 P
11	TX 6 N	35	RX 6 N	59	TX 16 N	83	RX 16 N
12	TX 6 P	36	RX 6 P	60	TX 16 P	84	RX 16 P
13	TX 5 N	37	RX 5 N	61	TX 15 N	85	RX 15 N
14	TX 5 P	38	RX 5 P	62	TX 15 P	86	RX 15 P
15	TX 4 N	39	RX 4 N	63	TX 14 N	87	RX 14 N
16	TX 4 P	40	RX 4 P	64	TX 14 P	88	RX 14 P
17	TX 3 N	41	RX 3 N	65	TX 13 N	89	RX 13 N
18	TX 3 P	42	RX 3 P	66	TX 13 P	90	RX 13 P

Table 3-14 E-1 Interface Pinouts on the FMEC E1-120PROB Card Ports 1 to 21 (continued)

Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name
19	TX 2 N	43	RX 2 N	67	TX 12 N	91	RX 12 N
20	TX 2 P	44	RX 2 P	68	TX 12 P	92	RX 12 P
21	TX 1 N	45	RX 1 N	69	NC	93	NC
22	TX 1 P	46	RX 1 P	70	NC	94	NC
23	NC	47	NC	71	NC	95	NC
24	NC	48	NC	72	NC	96	NC

Use Table 3-15 to make the connection from the E-1 96-pin connector for Ports 22 to 42 to the external balanced 120-ohm E-1 interfaces.

Table 3-15 E-1 Interface Pinouts on the FMEC E1-120PROB Card Ports 22 to 42

Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name
1	TX 32 N	25	RX 32 N	49	TX 42 N	73	RX 42 N
2	TX 32 P	26	RX 32 P	50	TX 42 P	74	RX 42 P
3	TX 31 N	27	RX 31 N	51	TX 41 N	75	RX 41 N
4	TX 31 P	28	RX 31 P	52	TX 41 P	76	RX 41 P
5	TX 30 N	29	RX 30 N	53	TX 40 N	77	RX 40 N
6	TX 30 P	30	RX 30 P	54	TX 40 P	78	RX 40 P
7	TX 29 N	31	RX 29 N	55	TX 39 N	79	RX 39 N
8	TX 29 P	32	RX 29 P	56	TX 39 P	80	RX 39 P
9	TX 28 N	33	RX 28 N	57	TX 38 N	81	RX 38 N
10	TX 28 P	34	RX 28 P	58	TX 38 P	82	RX 38 P
11	TX 27 N	35	RX 27 N	59	TX 37 N	83	RX 37 N
12	TX 27 P	36	RX 27 P	60	TX 37 P	84	RX 37 P
13	TX 26 N	37	RX 26 N	61	TX 36 N	85	RX 36 N
14	TX 26 P	38	RX 26 P	62	TX 36 P	86	RX 36 P
15	TX 25 N	39	RX 25 N	63	TX 35 N	87	RX 35 N
16	TX 25 P	40	RX 25 P	64	TX 35 P	88	RX 35 P
17	TX 24 N	41	RX 24 N	65	TX 34 N	89	RX 34 N
18	TX 24 P	42	RX 24 P	66	TX 34 P	90	RX 34 P
19	TX 23 N	43	RX 23 N	67	TX 33 N	91	RX 33 N
20	TX 23 P	44	RX 23 P	68	TX 33 P	92	RX 33 P
21	TX 22 N	45	RX 22 N	69	NC	93	NC
22	TX 22 P	46	RX 22 P	70	NC	94	NC

Table 3-15 E-1 Interface Pinouts on the FMEC E1-120PROB Card Ports 22 to 42 (continued)

Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name	Pin No.	Signal Name
23	NC	47	NC	71	NC	95	NC
24	NC	48	NC	72	NC	96	NC

3.13 E1-75/120 Impedance Conversion Panel

Note For specifications, see the "A.5.12 E1-75/120 Impedance Conversion Panel Specifications" section on page A-23.

The ONS 15454 SDH E1-75/120 impedance conversion panel provides front mount electrical connection for 42 ITU-compliant, G.703 E-1 ports. With the E1-75/120 conversion panel, each E1-42 port operates at 2.048 mbps over a 75-ohm unbalanced coaxial 1.0/2.3 miniature coax connector. Figure 3-12 shows the E1-75/120 faceplate.

Caution This interface can only be connected to SELV circuits. The interface is not intended for connection to any Australian telecommunications network without the written consent of the network manager.

Figure 3-12 E1-75/120 Impedance Conversion Panel Faceplate

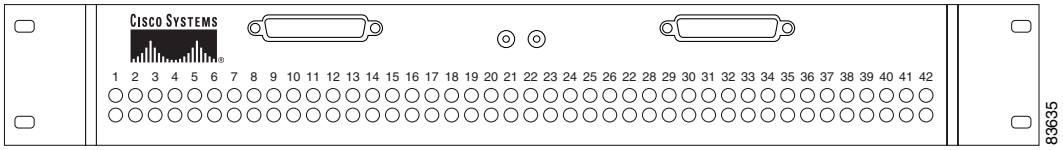


Figure 3-13 shows the E1-75/120 with optional rackmount brackets installed.

Figure 3-13 E1-75/120 with Optional Rackmount Brackets

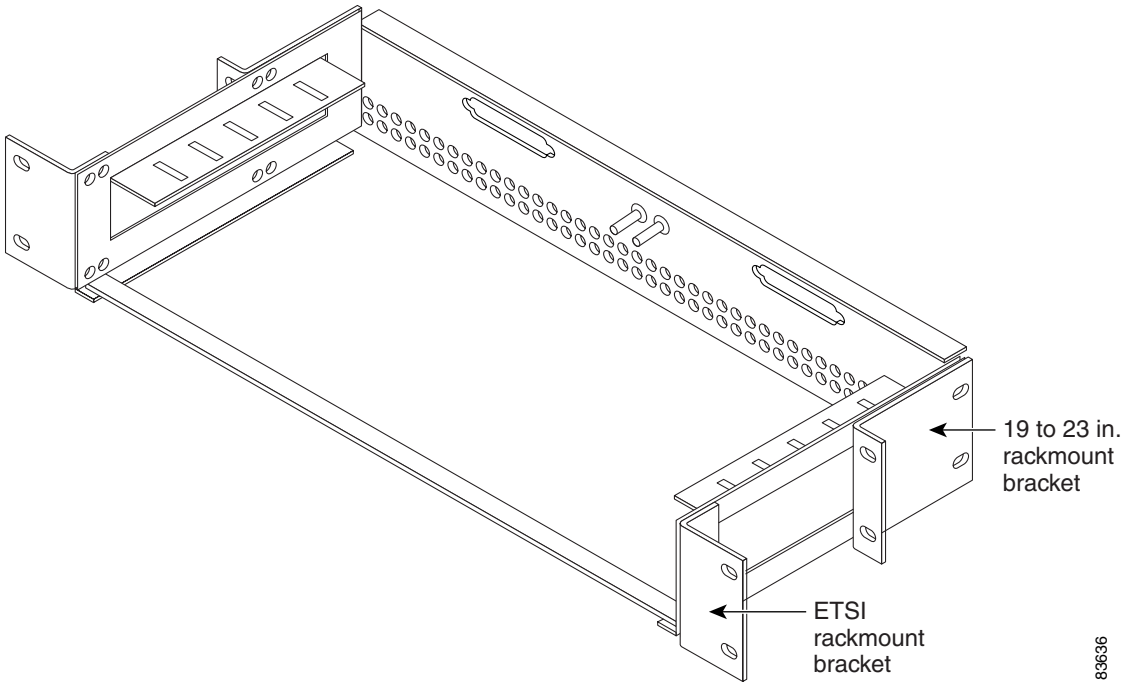
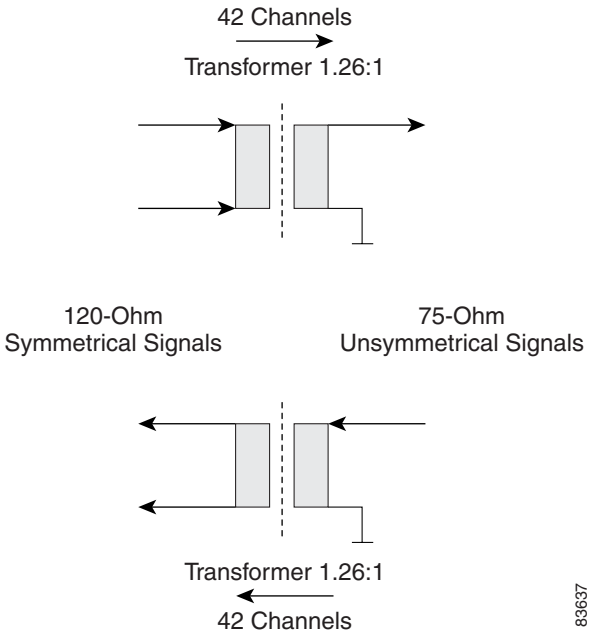


Figure 3-14 shows a block diagram of the impedance conversion panel.

Figure 3-14 E1-75/120 Impedance Conversion Panel Block Diagram



You can install the E1-75/120 conversion panel in the rack containing the ONS 15454 SDH shelf or in a nearby rack. If you install the E1-75/120 conversion panel in a place where a longer cable is required, make sure that the total cable loss of the balanced 120-ohm cable and the unbalanced 75-ohm cable does not exceed the maximum allowed value. The E1-75/120 conversion panel enables the use of 75-ohm interfaces on client side with the E1-42 card that has 120-ohm interfaces.

Before you can install the E1-75/120 in the rack, install the rackmount brackets that are required for the rack that you are using.

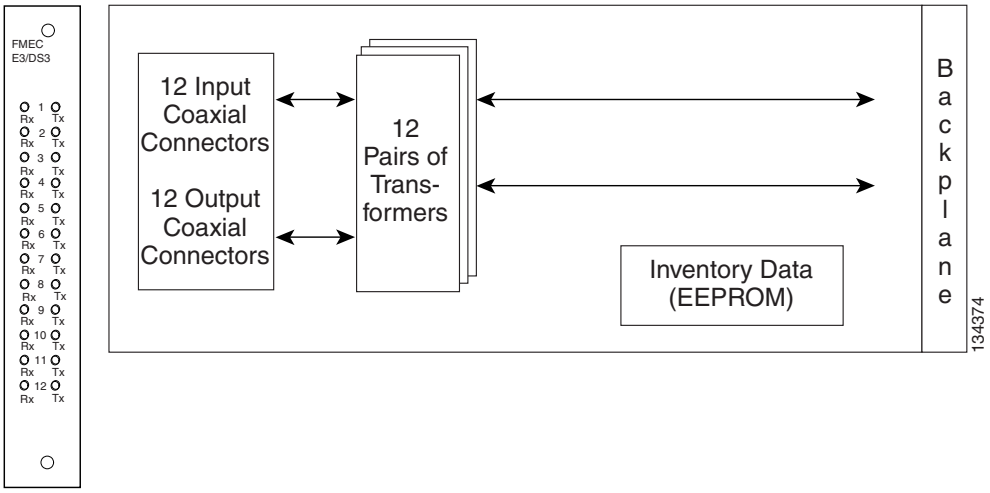
3.14 FMEC-E3/DS3 Card

Note For FMEC-E3/DS3 specifications, see the "A.5.13 FMEC-E3/DS3 Specifications" section on page A-24.

The ONS 15454 SDH FMEC-E3/DS3 card provides front mount electrical connection for 12 ITU-compliant, G.703 E-3 or DS-3 ports. With the FMEC-E3/DS3 card, each interface of an E3-12 card operates at 34.368 mbps and each interface of a DS3i-N-12 card operates at 44.736 mbps over a 75-ohm unbalanced coaxial 1.0/2.3 miniature coax connector. Figure 3-15 shows the FMEC-E3/DS3 faceplate and block diagram.

Caution This interface can only be connected to SELV circuits. The interface is not intended for connection to any Australian telecommunications network without the written consent of the network manager.

Figure 3-15 FMEC-E3/DS3 Faceplate and Block Diagram



You can install the FMEC-E3/DS3 card in any EFCA slot from Slot 18 to 22 or Slot 25 to 29 on the ONS 15454 SDH. Each FMEC-E3/DS3 card interface features E3-level or DS3-level inputs and outputs supporting cable losses:

- E3 signals
  - Up to 12 dB at 17184 kHz

- DS3 signals. One of the following:
  - Up to 137 m (450 ft) 734A, RG59, or 728A
  - Up to 24 m (79 ft) RG179

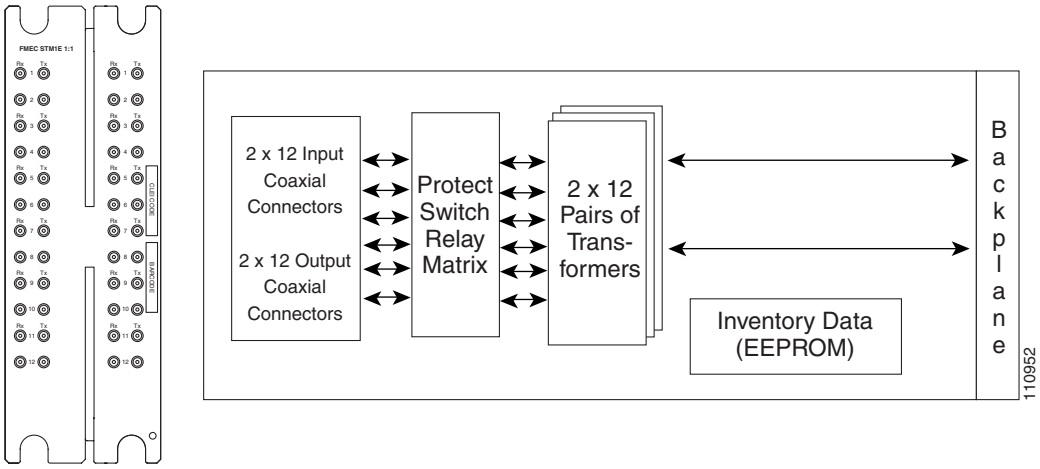
3.15 FMEC STM1E 1:1 Card

Note For FMEC STM1E 1:1 specifications, see the "A.5.14 FMEC STM1E 1:1 Specifications" section on page A-25.

The ONS 15454 SDH FMEC STM1E 1:1 card provides front mount electrical connection for 2 x 12 ITU-compliant, G.703 STM1E ports. With the FMEC STM1E 1:1 card, each interface of an STM1E-12 card operates at 155.52 mbps for STM-1 over a 75-ohm unbalanced coaxial 1.0/2.3 miniature coax connector. The FMEC STM1E 1:1 card is required if you want to use the STM1E-12 card in 1:1 protection mode or for connection to two unprotected STM1E-12 cards.

Figure 3-16 shows the FMEC STM1E 1:1 faceplate and block diagram.

Figure 3-16 FMEC STM1E 1:1 Faceplate and Block Diagram



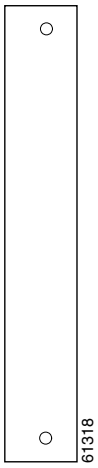
You can install the FMEC STM1E 1:1 card in any EFCA slot pair (18/19, 20/21, 26/27, or 28/29) on the ONS 15454 SDH. Each FMEC STM1E 1:1 card interface features STM1-level inputs and outputs supporting cable losses of up to 12.7 dB at 78 MHz.

3.16 BLANK-FMEC Faceplate

Note For BLANK-FMEC specifications, see the "A.5.15 BLANK-FMEC Specifications" section on page A-26.

The BLANK-FMEC sheet metal faceplate provides EMC emission control for empty FMEC slots. It also provides a way to close off the EFCA area, thus allowing air flow and convection to be maintained through the EFCA. You must install the BLANK-FMEC faceplate in every empty FMEC slot to maintain EMC requirements of the system and proper air flow. Figure 3-17 shows the BLANK-FMEC faceplate.

Figure 3-17 BLANK-FMEC Faceplate

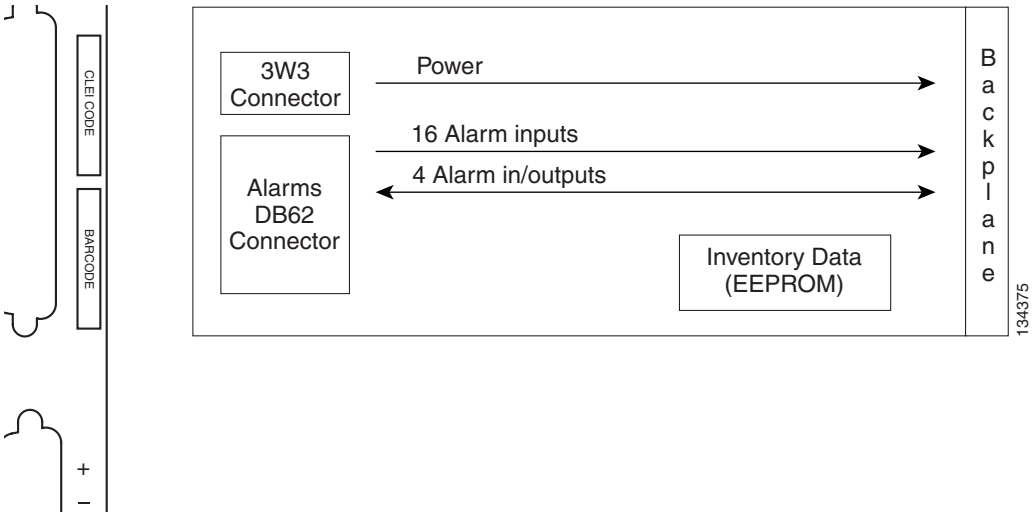


3.17 MIC-A/P FMEC

Note For MIC-A/P FMEC specifications, see the "A.5.16 MIC-A/P Specifications" section on page A-26.

The MIC-A/P FMEC provides connection for the BATTERY B input, one of the two possible redundant power supply inputs. It also provides connection for eight alarm outputs (coming from the TCC2/TCC2P card), sixteen alarm inputs, and four configurable alarm inputs/outputs. Its position is in Slot 23 in the center of the subrack EFCA area. Figure 3-18 shows the MIC-A/P faceplate and block diagram.

Figure 3-18 MIC-A/P Faceplate and Block Diagram



The MIC-A/P FMEC has the following features:

- Connection for one of the two possible redundant power supply inputs
- Connection for eight alarm outputs (coming from the TCC2/TCC2P card)
- Connection for four configurable alarm inputs/outputs
- Connection for sixteen alarm inputs
- Storage of manufacturing and inventory data

Note For proper system operation, both the MIC-A/P and the MIC-C/T/P FMECs must be installed in the ONS 15454 SDH shelf.

Note The MIC-A/P card controls whether FMEC cards on its side of the shelf appear in the CTC graphical user interface (GUI). For example, if the MIC-A/P is removed from the shelf, FMECs to the left of the card might disappear in CTC. This is normal behavior because when the MIC-A/P card is removed, communication can no longer be established with the disappeared FMECs. For more information, refer to the IMPROPROMVL entry in the "Alarm Troubleshooting" chapter of the *Cisco ONS 15454 SDH Troubleshooting Guide*.

Table 3-16 shows the alarm interface pinouts on the MIC-A/P DB-62 connector.

Table 3-16 Alarm Interface Pinouts on the MIC-A/P DB-62 Connector

Pin No.	Signal Name	Signal Description	Color
1	ALMCUTOFF N	Alarm cutoff, normally open ACO pair	White/blue
2	ALMCUTOFF P	Alarm cutoff, normally open ACO pair	Blue/white
3	ALMINP0 N	Alarm input pair 1, reports closure on connected wires	White/orange
4	ALMINP0 P	Alarm input pair 1, reports closure on connected wires	Orange/white
5	ALMINP1 N	Alarm input pair 2, reports closure on connected wires	White/green
6	ALMINP1 P	Alarm input pair 2, reports closure on connected wires	Green/white

Table 3-16 Alarm Interface Pinouts on the MIC-A/P DB-62 Connector (continued)

Pin No.	Signal Name	Signal Description	Color
7	ALMINP2 N	Alarm input pair 3, reports closure on connected wires	White/brown
8	ALMINP2 P	Alarm input pair 3, reports closure on connected wires	Brown/white
9	ALMINP3 N	Alarm input pair 4, reports closure on connected wires	White/gray
10	ALMINP3 P	Alarm input pair 4, reports closure on connected wires	Gray/white
11	EXALM0 N	External customer alarm 1	Red/blue
12	EXALM0 P	External customer alarm 1	Blue/red
13	GND	Frame ground	—
14	EXALM1 N	External customer alarm 2	Red/orange
15	EXALM1 P	External customer alarm 2	Orange/red
16	EXALM2 N	External customer alarm 3	Red/green
17	EXALM2 P	External customer alarm 3	Green/red
18	EXALM3 N	External customer alarm 4	Red/brown
19	EXALM3 P	External customer alarm 4	Brown/red
20	EXALM4 N	External customer alarm 5	Red/gray
21	EXALM4 P	External customer alarm 5	Gray/red
22	EXALM5 N	External customer alarm 6	Black/blue
23	EXALM5 P	External customer alarm 6	Blue/black
24	EXALM6 N	External customer alarm 7	Black/orange
25	EXALM6 P	External customer alarm 7	Orange/black
26	GND	Frame ground	—
27	EXALM7 N	External customer alarm 8	Black/green
28	EXALM7 P	External customer alarm 8	Green/black
29	EXALM8 N	External customer alarm 9	Black/brown
30	EXALM8 P	External customer alarm 9	Brown/black
31	EXALM9 N	External customer alarm 10	Black/gray
32	EXALM9 P	External customer alarm 10	Gray/black
33	EXALM10 N	External customer alarm 11	Amber/blue
34	EXALM10 P	External customer alarm 11	Blue/Amber
35	EXALM11 N	External customer alarm 12	Amber/orange
36	EXALM11 P	External customer alarm 12	Orange/Amber
37	ALMOUP0 N	Normally open output pair 1	White/blue
38	ALMOUP0 P	Normally open output pair 1	Blue/white
39	GND	Frame ground	—
40	ALMOUP1 N	Normally open output pair 2	White/orange
41	ALMOUP1 P	Normally open output pair 2	Orange/white
42	ALMOUP2 N	Normally open output pair 3	White/green

Table 3-16 Alarm Interface Pinouts on the MIC-A/P DB-62 Connector (continued)

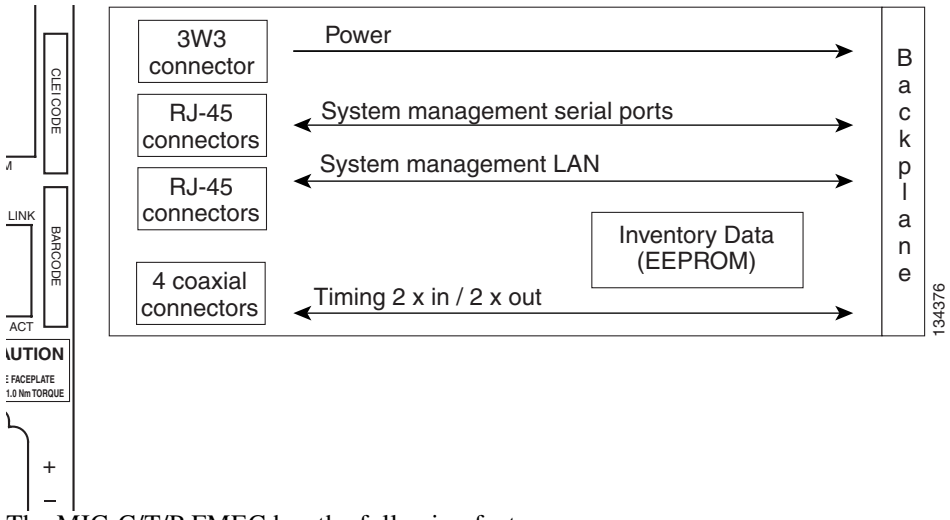
Pin No.	Signal Name	Signal Description	Color
43	ALMOUP2 P	Normally open output pair 3	Green/white
44	ALMOUP3 N	Normally open output pair 4	White/brown
45	ALMOUP3 P	Normally open output pair 4	Brown/white
46	AUDALM0 N	Normally open Minor audible alarm	White/gray
47	AUDALM0 P	Normally open Minor audible alarm	Gray/white
48	AUDALM1 N	Normally open Major audible alarm	Red/blue
49	AUDALM1 P	Normally open Major audible alarm	Blue/red
50	AUDALM2 N	Normally open Critical audible alarm	Red/orange
51	AUDALM2 P	Normally open Critical audible alarm	Orange/red
52	GND	Frame ground	—
53	AUDALM3 N	Normally open Remote audible alarm	Red/green
54	AUDALM3 P	Normally open Remote audible alarm	Green/red
55	VISALM0 N	Normally open Minor visual alarm	Red/brown
56	VISALM0 P	Normally open Minor visual alarm	Brown/red
57	VISALM1 N	Normally open Major visual alarm	Red/gray
58	VISALM1 P	Normally open Major visual alarm	Gray/red
59	VISALM2 N	Normally open Critical visual alarm	Black/blue
60	VISALM2 P	Normally open Critical visual alarm	Blue/black
61	VISALM3 N	Normally open Remote visual alarm	Black/orange
62	VISALM3 P	Normally open Remote visual alarm	Orange/black

3.18 MIC-C/T/P FMEC

Note For MIC-C/T/P FMEC specifications, see the "A.5.17 MIC-C/T/P Specifications" section on page A-27.

The MIC-C/T/P FMEC provides connection for the BATTERY A input, one of the two possible redundant power supply inputs. It also provides connection for system management serial port, system management LAN port, modem port (for future use), and system timing inputs and outputs. Install the MIC-C/T/P in Slot 24. Figure 3-19 shows the MIC-C/T/P faceplate and block diagram.

Figure 3-19 MIC-C/T/P Faceplate and Block Diagram



The MIC-C/T/P FMEC has the following features:

- Connection for one of the two possible redundant power supply inputs
- Connection for two serial ports for local craft/modem (for future use)
- Connection for one LAN port
- Connection for two system timing inputs
- Connection for two system timing outputs
- Storage of manufacturing and inventory data

Note For proper system operation, both the MIC-A/P and the MIC-C/T/P FMECs must be installed in the shelf.

The MIC-C/T/P FMEC has one pair of LEDs located on the RJ-45 LAN connector. The green LED is on when a link is present, and the amber LED is on when data is being transferred.

Optical Cards

This chapter describes the Cisco ONS 15454 SDH optical, transponder, and muxponder card features and functions. It includes descriptions, hardware specifications, and block diagrams for each card. For installation and card turn-up procedures, refer to the *Cisco ONS 15454 SDH Procedure Guide*.

Chapter topics include:

- 4.1 Optical Card Overview, page 4-1
- 4.2 OC3 IR 4/STM1 SH 1310 Card, page 4-5
- 4.3 OC3 IR/STM1 SH 1310-8 Card, page 4-7
- 4.4 OC12 IR/STM4 SH 1310 Card, page 4-8
- 4.5 OC12 LR/STM4 LH 1310 Card, page 4-10
- 4.6 OC12 LR/STM4 LH 1550 Card, page 4-12
- 4.7 OC12 IR/STM4 SH 1310-4 Card, page 4-14
- 4.8 OC48 IR/STM16 SH AS 1310 Card, page 4-16
- 4.9 OC48 LR/STM16 LH AS 1550 Card, page 4-18
- 4.10 OC48 ELR/STM16 EH 100 GHz Cards, page 4-20
- 4.11 OC192 SR/STM64 IO 1310 Card, page 4-23
- 4.12 OC192 IR/STM64 SH 1550 Card, page 4-24
- 4.13 OC192 LR/STM64 LH 1550 Card, page 4-26
- 4.14 OC192 LR/STM64 LH ITU 15xx.xx Card, page 4-30
- 4.15 15454_MRC-12 Multirate Card, page 4-33
- 4.16 OC192SR1/STM64IO Short Reach and OC192/STM64 Any Reach Cards, page 4-38
- 4.17 SFPs and XFPs, page 4-40

4.1 Optical Card Overview

The optical card overview section summarizes card functions and compatibility.

Note Each card is marked with a symbol that corresponds to a slot (or slots) on the ONS 15454 SDH shelf assembly. The cards are then installed into slots displaying the same symbols. See the "1.13.1 Card Slot Requirements" section on page 1-17 for a list of slots and symbols.

4.1.1 Card Summary

Table 4-1 lists the ONS 15454 SDH optical cards.

Table 4-1 Optical Cards for the ONS 15454 SDH

Card	Description	For Additional Information...
OC3 IR 4/STM1 SH 1310	The OC3 IR 4/STM1 SH 1310 card provides four intermediate- or short-range STM-1 ports and operates at 1310 nm. It operates in Slots 1 to 6 and 12 to 17.	See the "4.2 OC3 IR 4/STM1 SH 1310 Card" section on page 4-5.
OC3 IR/STM1 SH 1310-8	The OC3 IR/STM1SH 1310-8 card provides eight intermediate- or short-range STM-1 ports and operates at 1310 nm. It operates in Slots 1 to 4 and 14 to 17.	See the "4.3 OC3 IR/STM1 SH 1310-8 Card" section on page 4-7.
OC12 IR/STM4 SH 1310	The OC12 IR/STM4 SH 1310 card provides one intermediate- or short-range STM-4 port and operates at 1310 nm. It operates in Slots 1 to 6 and 12 to 17.	See the "4.4 OC12 IR/STM4 SH 1310 Card" section on page 4-8.
OC12 LR/STM4 LH 1310	The OC12 LR/STM4 LH 1310 card provides one long-range STM-4 port and operates at 1310 nm. It operates in Slots 1 to 6 and 12 to 17.	See the "4.5 OC12 LR/STM4 LH 1310 Card" section on page 4-10.
OC12 LR/STM4 LH 1550	The OC12 LR/STM4 LH 1550 card provides one long-range STM-4 port and operates at 1550 nm. It operates in Slots 1 to 6 and 12 to 17.	See the "4.6 OC12 LR/STM4 LH 1550 Card" section on page 4-12.
OC12 IR/STM4 SH 1310-4	The OC12 IR/STM4 SH 1310-4 card provides four intermediate- or short-range STM-4 ports and operates at 1310 nm. It operates in Slots 1 to 4 and 14 to 17.	See the "4.7 OC12 IR/STM4 SH 1310-4 Card" section on page 4-14.
OC48 IR/STM16 SH AS 1310	The OC48 IR/STM16 SH AS 1310 card provides one intermediate- or short-range STM-16 port at 1310 nm and operates in Slots 1 to 6 and 12 to 17.	See the "4.8 OC48 IR/STM16 SH AS 1310 Card" section on page 4-16.
OC48 LR/STM16 LH AS 1550	The OC48 LR/STM16 LH AS 1550 card provides one long-range STM-16 port at 1550 nm and operates in Slots 1 to 6 and 12 to 17.	See the "4.9 OC48 LR/STM16 LH AS 1550 Card" section on page 4-18.
OC48 ELR/STM16 EH 100 GHz	The OC48 ELR/STM16 EH 100 GHz card provides one long-range (enhanced) STM-16 port and operates in Slots 5, 6, 12, or 13. This card is available in 18 different wavelengths (9 in the blue band and 9 in the red band) in the 1550-nm range, every second wavelength in the ITU grid for 100-GHz spacing dense wavelength division multiplexing (DWDM).	See the "4.10 OC48 ELR/STM16 EH 100 GHz Cards" section on page 4-20.
OC192 SR/STM64 IO 1310	The OC192 SR/STM64 IO 1310 card provides one intra-office-haul STM-64 port at 1310 nm and operates in Slots 5, 6, 12, or 13 with the XC-VXL-10G or XC-VXC-10G cross-connect card.	See the "4.11 OC192 SR/STM64 IO 1310 Card" section on page 4-23.
OC192 IR/STM64 SH 1550	The OC192 IR/STM64 SH 1550 card provides one intermediate-range STM-64 port at 1550 nm and operates in Slots 5, 6, 12, or 13 with the XC-VXL-10G or XC-VXC-10G cross-connect card.	See the "4.12 OC192 IR/STM64 SH 1550 Card" section on page 4-24.

Table 4-1 Optical Cards for the ONS 15454 SDH (continued)

Card	Description	For Additional Information...
OC192 LR/STM64 LH 1550	The OC192 LR/STM64 LH 1550 card provides one long-range STM-64 port at 1550 nm and operates in Slots 5, 6, 12, or 13 with the XC-VXL-10G or XC-VXC-10G cross-connect card.	See the "4.13 OC192 LR/STM64 LH 1550 Card" section on page 4-26.
OC192 LR/STM64 LH ITU 15xx.xx	The OC192 LR/STM64 LH ITU 15xx.xx card provides one extended long-range STM-64 port and operates in Slots 5, 6, 12, or 13 with the XC-VXC-10G card. This card is available in multiple wavelengths in the 1550-nm range of the ITU grid for 100-GHz-spaced DWDM.	See the "4.14 OC192 LR/STM64 LH ITU 15xx.xx Card" section on page 4-30.
15454_MRC-12	The 15454_MRC-12 card provides up to twelve STM-1 or STM-4 ports, or up to four STM-16 ports, using small form factor pluggables (SFPs). The card operates in Slots 1 to 6 and 12 to 17.	See the "4.15 15454_MRC-12 Multirate Card" section on page 4-33.
OC192SR1/ STM-64IO Short Reach/ OC192/STM64IO Any Reach[1]	The OC192SR1/STM64 Short Reach and OC192/STM64 Any Reach cards provide a single OC-192/STM-64 interface capable of operating with SR-1, IR-2, and LR-2 XFP modules (depending on the card) at 1310 nm and 1550 nm. The cards operate in slots 5, 6, 12, or 13 with the XC-VXL-10G and XC-VXC-10G cards.	See the "4.16 OC192SR1/STM64IO Short Reach and OC192/STM64 Any Reach Cards" section on page 4-38.

1. CTC refers to these cards as STM64-XFP

Note The Cisco OC3 IR/STM1 SH 1310-8, OC12 IR/STM4 SH 1310, and OC48 IR/STM16 SH AS 1310 interface optics, all working at 1310 nm, are optimized for the most widely used SMF-28 fiber, available from many suppliers.

Corning MetroCor fiber is optimized for optical interfaces that transmit at 1550 nm or in the C and L DWDM windows, and targets interfaces with higher dispersion tolerances than those found in OC3 IR/STM1 SH 1310-8, OC12 IR/STM4 SH 1310, and OC48 IR/STM16 SH AS1310 interface optics. If you are using Corning MetroCor fiber, OC3 IR/STM1 SH 1310-8, OC12 IR/STM4 SH 1310, and OC48 IR/STM16 SH AS 1310 interface optics become dispersion limited before they become attenuation limited. In this case, consider using OC12 LR/STM4 LH 1550 and OC48 LR/STM16 LH 1550 AS cards instead of OC12 IR/STM4 SH and OC48 IR/STM16 SH cards.

With all fiber types, network planners/engineers should review the relative fiber type and optics specifications to determine attenuation, dispersion, and other characteristics to ensure appropriate deployment.

4.1.2 Card Compatibility

Table 4-2 lists the CTC software compatibility for each optical card. See Table 2-5 on page 2-4 for a list of cross-connect cards that are compatible with each optical card.

Note "Yes" indicates that this card is fully or partially supported by the indicated software release. Refer to the individual card reference section for more information about software limitations for this card.

Table 4-2 Optical Card Software Release Compatibility

Optical Card	R2.2.1	R2.2.2	R3.0.1	R3.1	R3.2	R3.3	R3.4	R4.0	R4.1	R4.5	R4.6	R4.7	R5.0	R6.0	R7.0
OC3 IR 4/STM1 SH 1310	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	Yes	—	Yes	Yes	Yes
OC3 IR /STM1 SH 1310-8	—	—	—	—	—	—	—	Yes	Yes	—	Yes	—	Yes	Yes	Yes
OC12 IR/STM4 SH 1310	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	Yes	—	Yes	Yes	Yes
OC12 LR/STM4 LH 1310	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	Yes	—	Yes	Yes	Yes
OC12 LR/STM4 LH 1550	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	Yes	—	Yes	Yes	Yes
OC12 IR/STM4 SH 1310-4	—	—	—	—	—	Yes	Yes	Yes	Yes	—	Yes	—	Yes	Yes	Yes
OC48 IR/STM16 SH AS 1310	—	—	—	Yes	Yes	Yes	Yes	Yes	Yes	—	Yes	—	Yes	Yes	Yes
OC48 LR/STM16 LH AS 1550	—	—	—	Yes	Yes	Yes	Yes	Yes	Yes	—	Yes	—	Yes	Yes	Yes
OC48 ELR/STM16 EH 100 GHz	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	Yes	—	Yes	Yes	Yes
OC48 ELR 200 GHz	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	Yes	—	Yes	Yes	Yes
OC192 SR/STM64 IO 1310	—	—	—	—	—	—	—	Yes	Yes	—	Yes	—	Yes	Yes	Yes
OC192 IR/STM64 SH 1550	—	—	—	—	—	—	—	Yes	Yes	—	Yes	—	Yes	Yes	Yes
OC192 LR/STM64 LH 1550 (15454-OC192LR1550)	—	—	—	Yes	Yes	Yes	Yes	Yes	Yes	—	Yes	—	Yes	Yes	Yes
OC192 LR/STM64 LH 1550 (15454-OC192-LR2)	—	—	—	—	—	—	—	Yes	Yes	—	Yes	—	Yes	Yes	Yes
OC192 LR/STM64 LH ITU 15xx.xx	—	—	—	—	—	—	—	Yes	Yes	—	Yes	—	Yes	Yes	Yes
15454_MRC-12	—	—	—	—	—	—	—	—	—	—	—	—	—	Yes	Yes
OC192SR1/STM64IO Short Reach/ OC192/STM64 Any Reach[1]	—	—	—	—	—	—	—	—	—	—	—	—	—	Yes	Yes

1. These cards are designated as STM64-XFP in CTC

4.2 OC3 IR 4/STM1 SH 1310 Card

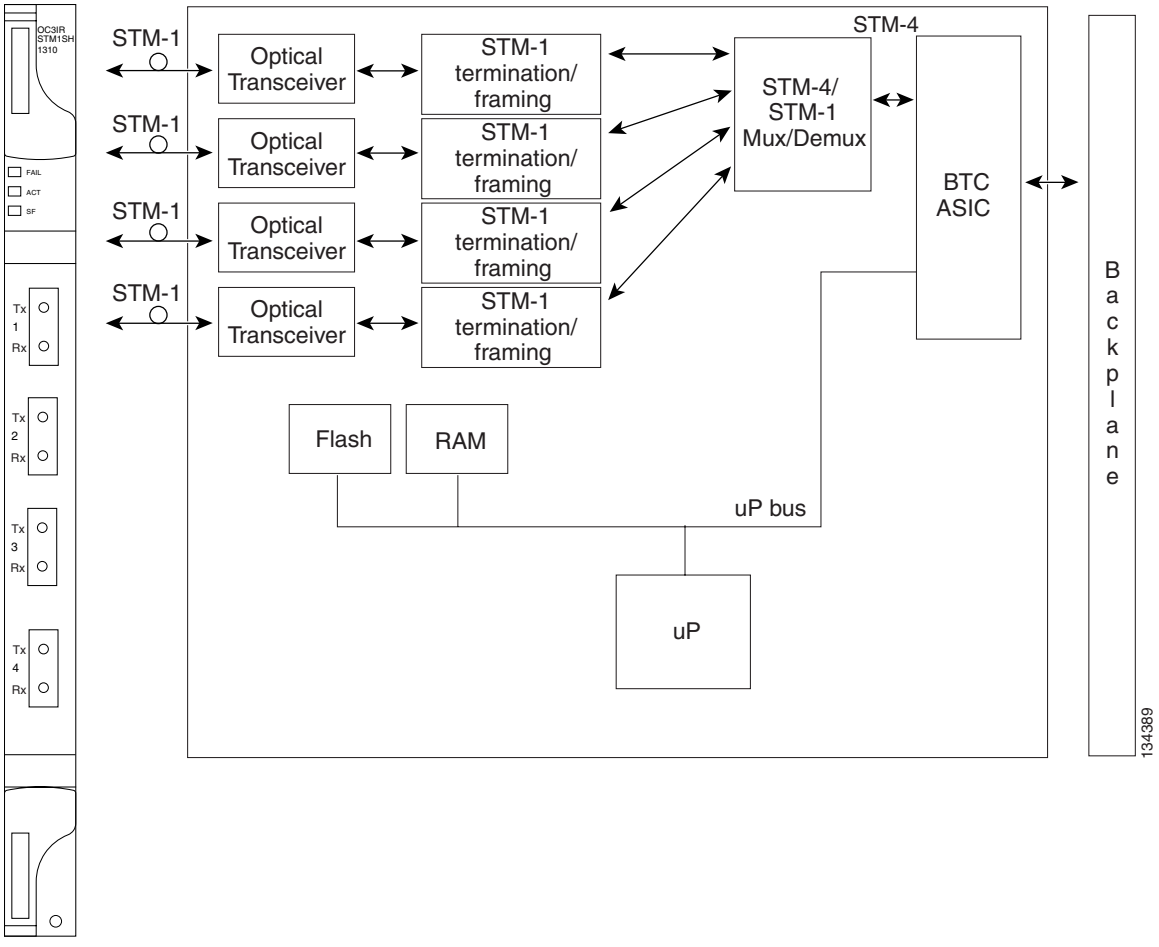
Note For specifications, see the "A.6.1 OC3 IR 4/STM1 SH 1310 Card Specifications" section on page A-28.

The OC3 IR 4/STM1 SH 1310 card provides four intermediate or short range SDH STM-1 ports compliant with ITU-T G.707 and ITU-T G.957. Each port operates at 155.52 Mbps over a single-mode fiber span. The card supports VC-4 and nonconcatenated or concatenated payloads at the STM-1 signal level.

Warning **The laser is on when the optical card is booted. The port does not have to be in service for the laser to be on.**

Figure 4-1 shows the OC3 IR 4/STM1 SH 1310 faceplate and block diagram.

Figure 4-1 OC3 IR 4/STM1 SH 1310 Faceplate and Block Diagram



4.2.1 OC3 IR 4/STM1 SH 1310 Functionality

You can install the OC3 IR 4/STM1 SH 1310 card in Slots 1 to 6 and 12 to 17. The card can be provisioned as part of a subnetwork connection protection (SNCP) ring or linear add-drop multiplexer (ADM) configuration. Each interface features a 1310-nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses SC connectors.

The OC3 IR 4/STM1 SH 1310 card supports 1+1 unidirectional and bidirectional protection switching. You can provision protection on a per port basis.

The OC3 IR 4/STM1 SH 1310 card detects loss of signal (LOS), loss of frame (LOF), loss of pointer (LOP), multiplex section alarm indication signal (MS-AIS), and multiplex section far-end receive failure (MS-FERF) conditions. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line bit interleaved parity (BIP) errors.

To enable multiplex section protection (MSP), the OC3 IR 4/STM1 SH 1310 card extracts the K1 and K2 bytes from the SDH overhead to perform appropriate protection switches. The data communication channel/generic communication channel (GCC) bytes are forwarded to the TCC2 card, which terminates the GCC.

4.2.2 OC3 IR 4/STM1 SH 1310 Card-Level Indicators

Table 4-3 describes the three card-level LED indicators on the OC3 IR 4/STM1 SH 1310 card.

Table 4-3 OC3 IR 4/STM1 SH 1310 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card processor is not ready. The FAIL LED is on during reset and flashes during the boot process. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the card is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, MS-AIS, or high BER on one or more card ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the links are working, the light turns off.

4.2.3 OC3 IR 4/STM1 SH 1310 Port-Level Indicators

Eight bicolor LEDs show the status per port. The LEDs shows green if the port is available to carry traffic, is provisioned as in-service, and is part of a protection group, in the active mode. You can find the status of the four card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.3 OC3 IR/STM1 SH 1310-8 Card

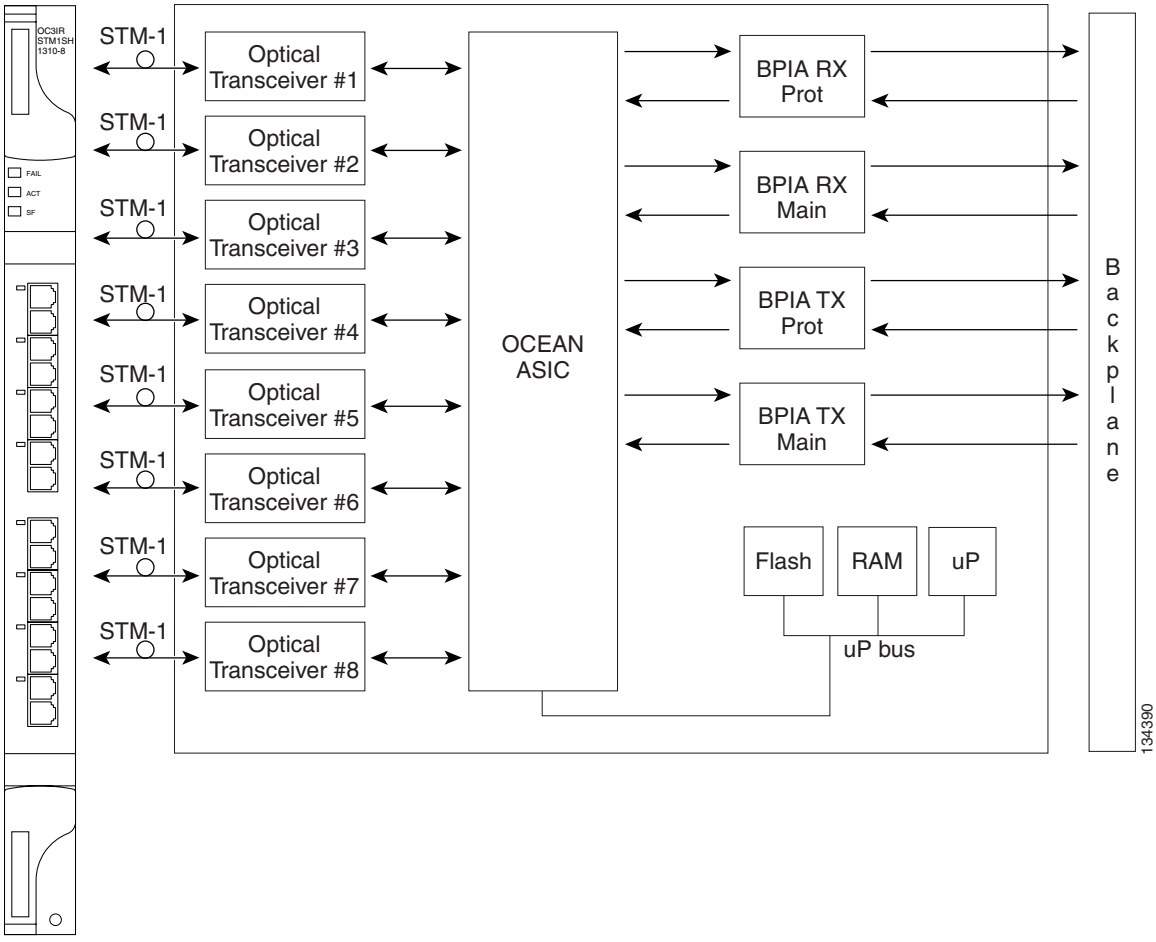
Note For specifications, see the "A.6.2 OC3 IR/STM1 SH 1310-8 Card Specifications" section on page A-29.

The OC3 IR/STM1 SH 1310-8 card provides eight intermediate or short range SDH STM-1 ports compliant with ITU-T G.707, and ITU-T G.957. Each port operates at 155.52 Mbps over a single-mode fiber span. The card supports VC-4 and nonconcatenated or concatenated payloads at the STM-1 signal level.

Warning **The laser is on when the optical card is booted. The port does not have to be in service for the laser to be on.**

Figure 4-2 shows the card faceplate and block diagram.

Figure 4-2 OC3 IR/STM1 SH 1310-8 Faceplate and Block Diagram



You can install the OC3IR/STM1 SH 1310-8 card in Slots 1 to 4 and 14 to 17. The card can be provisioned as part of an SNCP or in an (ADM) configuration. Each interface features a 1310-nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses LC connectors on the faceplate, angled downward 12.5 degrees.

The OC3IR/STM1 SH 1310-8 card supports 1+1 unidirectional and bidirectional protection switching. You can provision protection on a per port basis.

The OC3IR/STM1 SH 1310-8 card detects loss of signal (LOS), loss of frame (LOF), loss of pointer (LOP), multiplex section alarm indicator signal (MS-AIS), and multiplex section far-end receive failure (MS-FERF) conditions. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors.

To enable an MS-SPRing, the OC3 IR/STM1 SH 1310-8 card extracts the K1 and K2 bytes from the SDH overhead to perform appropriate protection switches. The OC3IR/STM1 SH 1310-8 card supports full GCC connectivity for remote network management.

4.3.1 OC3 IR/STM1 SH 1310-8 Card-Level Indicators

Table 4-4 describes the three card-level LED indicators for the OC3IR/STM1 SH 1310-8 card.

Table 4-4 OC3IR/STM1 SH 1310-8 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card processor is not ready. The FAIL LED is on during reset and flashes during the boot process. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the card is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, MS-AIS, or high BER on one or more card ports. The amber signal fail (SF) LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the links are working, the light turns off.

4.3.2 OC3 IR/STM1 SH 1310-8 Port-Level Indicators

Eight bicolor LEDs show the status per port. The LEDs shows green if the port is available to carry traffic, is provisioned as in-service, is part of a protection group, or in the active mode. You can also find the status of the eight card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.4 OC12 IR/STM4 SH 1310 Card

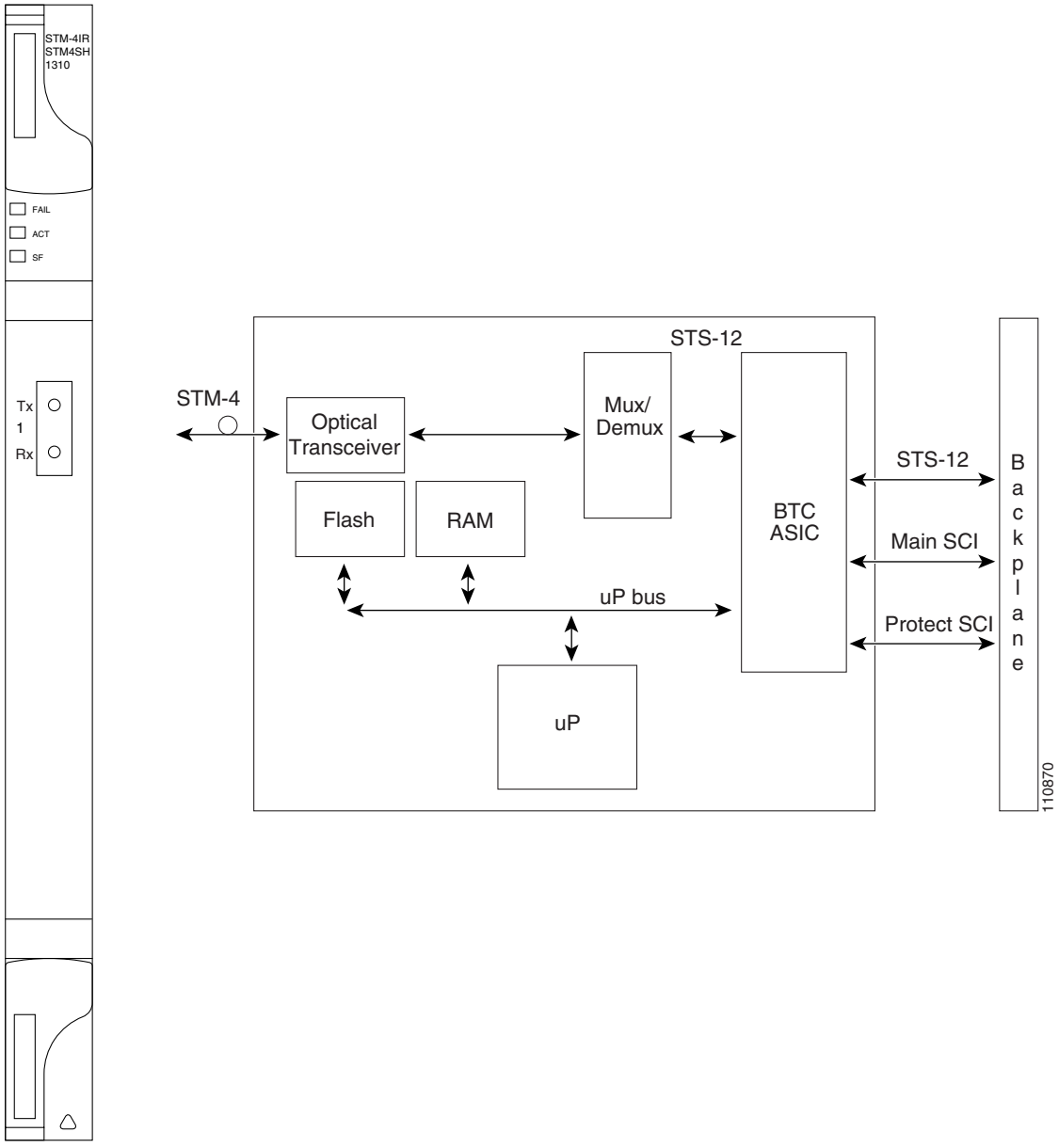
Note For specifications, see the "A.6.3 OC12 IR/STM4 SH 1310 Card Specifications" section on page A-30.

The OC12 IR/STM4 SH 1310 card provides one intermediate or short range SDH STM-4 port compliant with ITU-T G.707 and ITU-T G.957. The port operates at 622.08 Mbps over a single-mode fiber span. The card supports VC-4 and nonconcatenated or concatenated payloads at STM-1 and STM-4 signal levels.

Warning **The laser is on when the optical card is booted. The port does not have to be in service for the laser to be on.**

Figure 4-3 shows the OC12 IR/STM4 SH 1310 faceplate and a block diagram of the card.

Figure 4-3 OC12 IR/STM4 SH 1310 Faceplate and Block Diagram



You can install the OC12 IR/STM4 SH 1310 card in Slots 1 to 6 and 12 to 17 and provision the card as part of an MS-SPRing or subnetwork connection protection (SNCP) ring. In ADM configurations, you can provision the card as either an access tributary or a transport span (trunk) side interface.

The OC12 IR/STM4 SH 1310 card interface features a 1310-nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The OC12 IR/STM4 SH 1310 card uses SC optical connections and supports 1+1 unidirectional and bidirectional protection.

The OC12 IR/STM4 SH 1310 detects LOS, LOF, LOP, MS-AIS, and MS-FERF conditions. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors.

To enable an MS-SPRing, the OC12 IR/STM4 SH 1310 extracts the K1 and K2 bytes from the SDH overhead to perform appropriate protection switches. The GCC bytes are forwarded to the TCC2 card, which terminates the GCC.

4.4.1 OC12 IR/STM4 SH 1310 Card-Level Indicators

Table 4-5 describes the three card-level LED indicators on the OC12 IR/STM4 SH 1310 card.

Table 4-5 OC12 IR/STM4 SH 1310 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card processor is not ready. The FAIL LED is on during reset and flashes during the boot process. Replace the card if the red FAIL LED persists.
Green/Amber ACT LED	The green ACT LED indicates that the card is operational and is carrying traffic or is traffic-ready. The amber ACT LED indicates that the card is in standby mode or is part of an active ring switch (MS-SPRing).
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, MS-AIS, or high BERs on one or more card ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.4.2 OC12 IR/STM4 SH 1310 Port-Level Indicators

You can find the status of the OC12 IR/STM4 SH 1310 card port using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.5 OC12 LR/STM4 LH 1310 Card

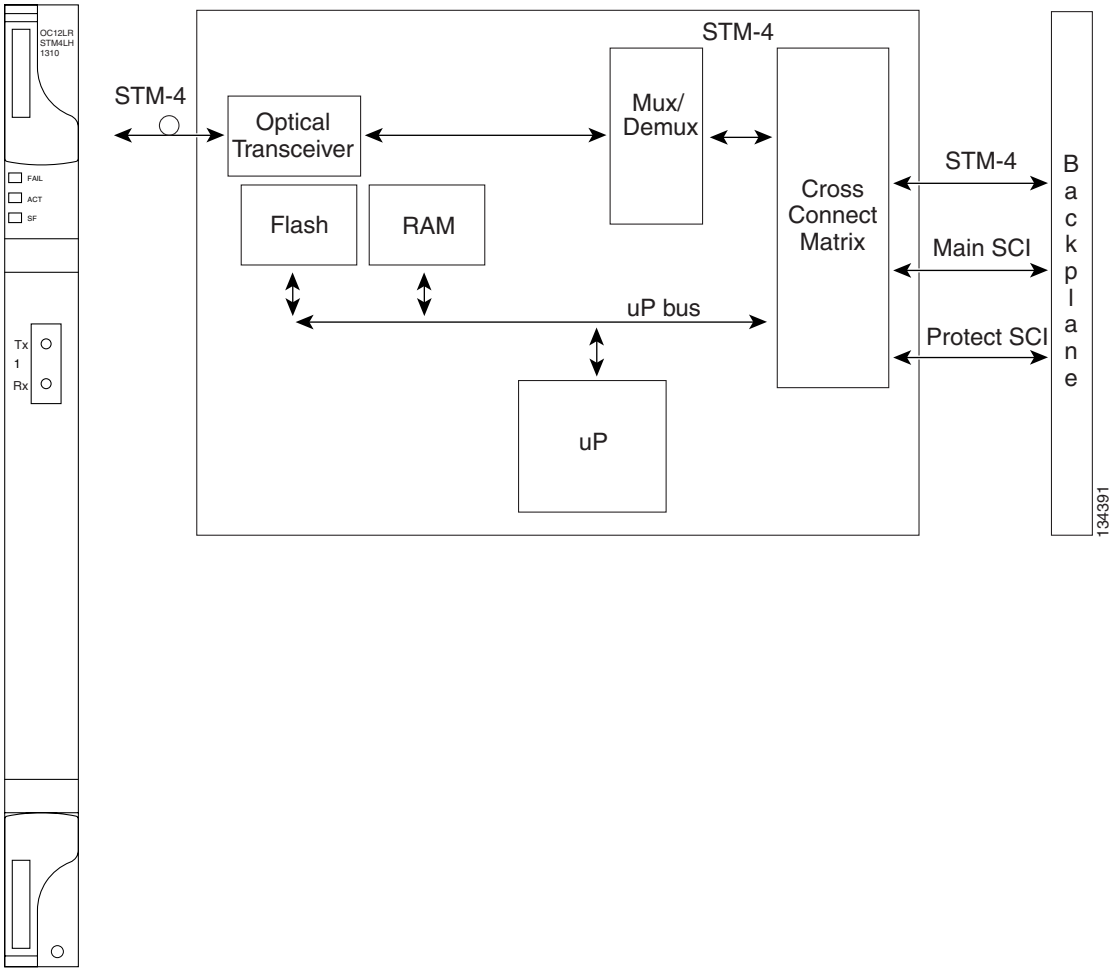
Note For specifications, see the "A.6.4 OC12 LR/STM4 LH 1310 Card Specifications" section on page A-31.

The OC12 LR/STM4 LH 1310 card provides one long-range SDH STM-4 port per card compliant with ITU-T G.707, and ITU-T G.957. The port operates at 622.08 Mbps over a single-mode fiber span. The card supports VC-4 and nonconcatenated or concatenated payloads at STM-1 and STM-4 signal levels.

Warning **The laser is on when the optical card is booted. The port does not have to be in service for the laser to be on.**

Figure 4-4 shows the OC12 LR/STM4 LH 1310 faceplate and block diagram.

Figure 4-4 OC12 LR/STM4 LH 1310 Faceplate and Block Diagram



You can install the OC12 LR/STM4 LH 1310 card in Slots 1 to 6 and 12 to 17 and provision the card as part of an MS-SPRing or SNCP ring. In ADM configurations, you can provision the card as either an access tributary or a transport span-side interface.

The OC12 LR/STM4 LH 1310 card interface features a 1310-nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses SC optical connections and supports 1+1 unidirectional and bidirectional protection.

The OC12 LR/STM4 LH 1310 detects LOS, LOF, LOP, MS-AIS, and MS-FERF conditions. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors.

To enable an MS-SPRing, the OC12 LR/STM4 LH 1310 extracts the K1 and K2 bytes from the SDH overhead to perform appropriate protection switches. The GCC bytes are forwarded to the TCC2 card, which terminates the GCC.

4.5.1 OC12 LR/STM4 LH 1310 Card-Level Indicators

Table 4-6 describes the three card-level LED indicators on the OC12 LR/STM4 LH 1310 card.

Table 4-6 OC12 LR/STM4 LH 1310 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card processor is not ready. The FAIL LED is on during reset and flashes during the boot process. Replace the card if the red FAIL LED persists.
Green/Amber ACT LED	The green ACT LED indicates that the card is operational and is carrying traffic or is traffic-ready. The amber ACT LED indicates that the card is in standby mode or is part of an active ring switch (MS-SPRing).
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, MS-AIS, or high BERs on one or more card ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.5.2 OC12 LR/STM4 LH 1310 Port-Level Indicators

You can find the status of the OC12 LR/STM4 LH 1310 card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.6 OC12 LR/STM4 LH 1550 Card

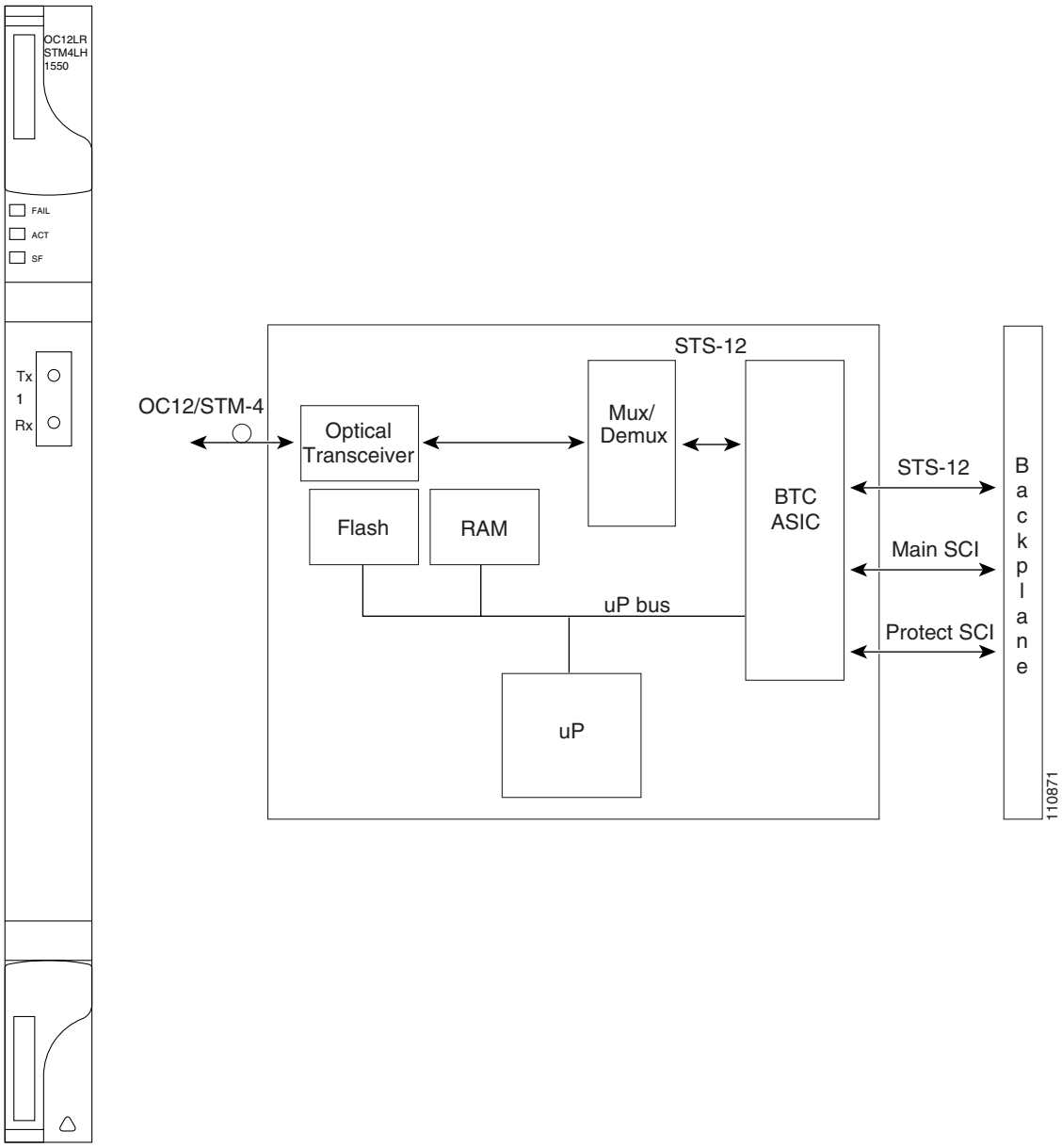
Note For specifications, see the "A.6.5 OC12 LR/STM4 LH 1550 Card Specifications" section on page A-32.

The OC12 LR/STM4 LH 1550 card provides one long-range, ITU-T G.707- and G.957-compliant, SDH STM-4 port per card. The interface operates at 622.08 Mbps over a single-mode fiber span. The card supports concatenated or nonconcatenated payloads on a per VC-4 basis. Figure 4-5 shows the OC12 LR/STM4 LH 1550 faceplate.

Warning **The laser is on when the optical card is booted. The port does not have to be in service for the laser to be on.**

Figure 4-5 shows the OC12 LR/STM4 LH 1550 faceplate and a block diagram of the card.

Figure 4-5 OC12 LR/STM4 LH 1550 Faceplate and Block Diagram



4.6.1 OC12 LR/STM4 LH 1550 Card Functionality

You can install the OC12 LR/STM4 LH 1550 card in Slots 1 to 6 or 12 to 17. You can provision the card as part of an MS-SPRing or SNCP ring. In ADM configurations, you can provision the card as either an access tributary or a transport span-side interface.

The OC12 LR/STM4 LH 1550 card uses long-reach optics centered at 1550 nm and contains a transmit and receive connector (labeled) on the card faceplate. The OC12 LR/STM4 LH 1550 card uses SC optical connections and supports 1+1 bidirectional or unidirectional protection switching.

The OC12 LR/STM4 LH 1550 card detects LOS, LOF, LOP, MS-AIS, and MS-FERF conditions. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors.

To enable an MS-SPRing, the OC12 LR/STM4 LH 1550 extracts the K1 and K2 bytes from the SDH overhead and processes them to switch accordingly. The GCC bytes are forwarded to the TCC2 card, which terminates the GCC.

4.6.2 OC12 LR/STM4 LH 1550 Card-Level Indicators

Table 4-7 describes the three card-level LED indicators on the OC12 LR/STM4 LH 1550 card.

Table 4-7 OC12 LR/STM4 LH 1550 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card processor is not ready. The FAIL LED is on during reset and flashes during the boot process. Replace the card if the red FAIL LED persists.
Green/Amber ACT LED	The green ACT LED indicates that the card is operational and ready to carry traffic. The amber ACT LED indicates that the card is in standby mode or is part of an active ring switch (MS-SPRing).
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, MS-AIS, or high BERs on one or more card ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.6.3 OC12 LR/STM4 LH 1550 Port-Level Indicators

You can find the status of the OC12 LR/STM4 LH 1550 card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.7 OC12 IR/STM4 SH 1310-4 Card

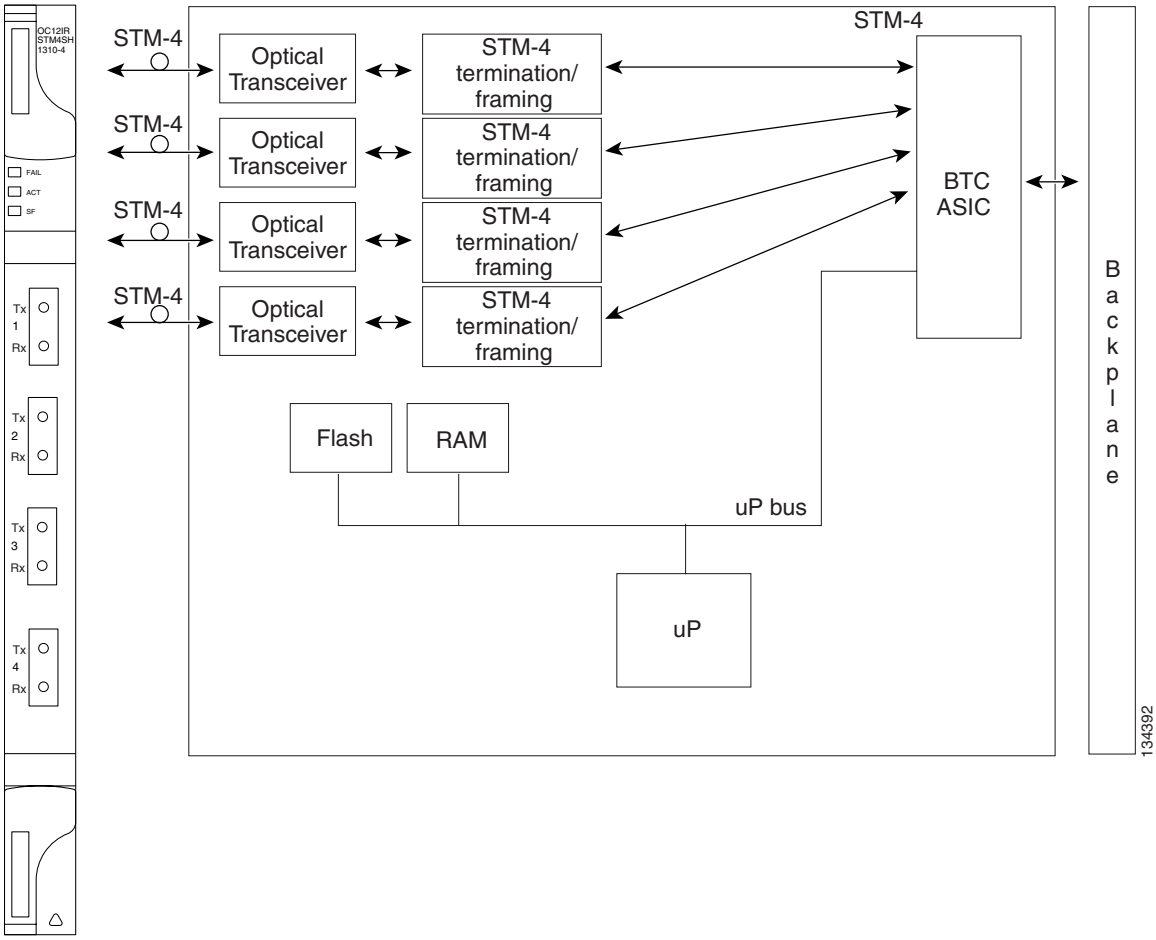
Note For specifications, see the "A.6.6 OC12 IR/STM4 SH 1310-4 Card Specifications" section on page A-33.

The OC12 IR/STM4 SH 1310-4 card provides four intermediate or short range SDH STM-4 ports compliant with ITU-T G.707, and ITU-T G.957. Each port operates at 622.08 Mbps over a single-mode fiber span. The card supports concatenated or nonconcatenated payloads on a per VC-4 basis.

Warning **The laser is on when the optical card is booted. The port does not have to be in service for the laser to be on.**

Figure 4-6 shows the OC12 IR/STM4 SH 1310-4 faceplate and block diagram.

Figure 4-6 OC12 IR/STM4 SH 1310-4 Faceplate and Block Diagram



4.7.1 OC12 IR/STM4 SH 1310-4 Card Functionality

You can install the OC12 IR/STM4 SH 1310-4 card in Slots 1 to 4 and 14 to 17. The card can be provisioned as part of an SNCP, part of an MS-SPRing, or in an ADM/TM configuration. Each interface features a 1310-nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses SC connectors.

The OC12 IR/STM4 SH 1310-4 card supports 1+1 unidirectional and bidirectional protection switching. You can provision protection on a per port basis.

The OC12 IR/STM4 SH 1310-4 card detects LOS, LOF, LOP, MS-AIS, and MS-FERF conditions. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors.

Each port is configurable to support all ONS 15454 SDH configurations and can be provisioned as part of an MS-SPRing or SNCP configuration.

To enable an MS-SPRing, the OC12 IR/STM4 SH 1310-4 card extracts the K1 and K2 bytes from the SDH overhead and processes them to switch accordingly. The GCC bytes are forwarded to the TCC2 card, which terminates the GCC.

Note If you ever expect to upgrade an OC-12/STM-4 ring to a higher bit rate, you should not put an OC12 IR/STM4 SH 1310-4 card in that ring. The four-port card is not upgradable to a single-port card. The reason is that four different spans, possibly going to four different nodes, cannot be merged to a single span.

4.7.2 OC12 IR/STM4 SH 1310-4 Card-Level Indicators

Table 4-8 describes the three card-level LED indicators on the OC12 IR/STM4 SH 1310-4 card.

Table 4-8 OC12 IR/STM4 SH 1310-4 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card processor is not ready. The FAIL LED is on during reset and flashes during the boot process. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the card is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, MS-AIS, or high BER on one or more card ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the links are working, the light turns off.

4.7.3 OC12 IR/STM4 SH 1310-4 Port-Level Indicators

You can find the status of the four card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.8 OC48 IR/STM16 SH AS 1310 Card

Note For specifications, see the "A.6.7 OC48 IR/STM16 SH AS 1310 Card Specifications" section on page A-34.

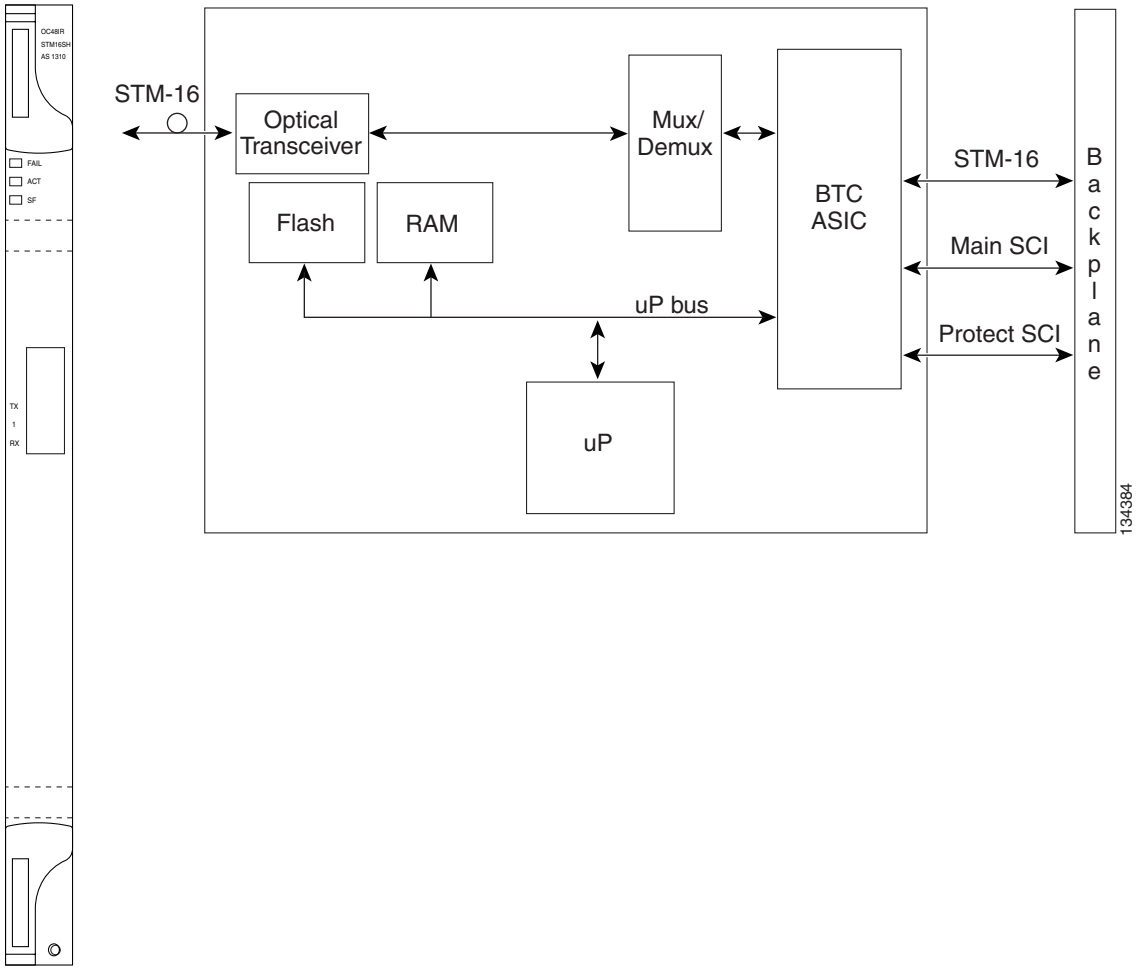
Note Any new features that are available as part of this software release are not enabled for this card.

The OC48 IR/STM16 SH AS 1310 card provides one intermediate-range, ITU-T G.707- and G.957-compliant, SDH STM-16 port per card. The interface operates at 2.488 Gbps over a single-mode fiber span. The card supports concatenated or nonconcatenated payloads at STM-1, STM-4, or STM-16 signal levels on a per VC-4 basis.

Warning **The laser is on when the optical card is booted. The port does not have to be in service for the laser to be on.**

Figure 4-7 shows the OC48 IR/STM16 SH AS 1310 faceplate and block diagram.

Figure 4-7 OC48 IR/STM16 SH AS 1310 Faceplate and Block Diagram



4.8.1 OC48 IR/STM16 SH AS 1310 Card Functionality

You can install the OC48 IR/STM16 SH AS 1310 card in Slots 1 to 6 and 12 to 17. You can provision the card as part of a MS-SPRing or SNCP. In an ADM configuration, you can provision the card as either an access tributary or a transport span interface.

The STM-16 port features a 1310-nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The OC48 IR/STM16 SH AS 1310 card uses SC connectors. The card supports 1+1 unidirectional protection and provisionable bidirectional switching.

The OC48 IR/STM16 SH AS 1310 card detects LOS, LOF, LOP, MS-AIS, and MS-FERF conditions. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors.

4.8.2 OC48 IR/STM16 SH AS 1310 Card-Level Indicators

Table 4-9 describes the three card-level LED indicators on the OC48 IR/STM16 SH AS 1310 card.

Table 4-9 OC48 IR/STM16 SH AS 1310 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card processor is not ready. The FAIL LED is on during reset and flashes during the boot process. Replace the card if the red FAIL LED persists.
Green/Amber ACT LED	The green ACT LED indicates that the card is carrying traffic or is traffic-ready. The amber ACT LED indicates that the card is in standby mode or is part of an active ring switch (MS-SPRing).
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, MS-AIS, or high BERs on one or more card ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.8.3 OC48 IR/STM16 SH AS 1310 Port-Level Indicators

You can find the status of the OC48 IR/STM16 SH AS 1310 card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.9 OC48 LR/STM16 LH AS 1550 Card

Note For specifications, see the "A.6.8 OC48 LR/STM16 LH AS 1550 Card Specifications" section on page A-34.

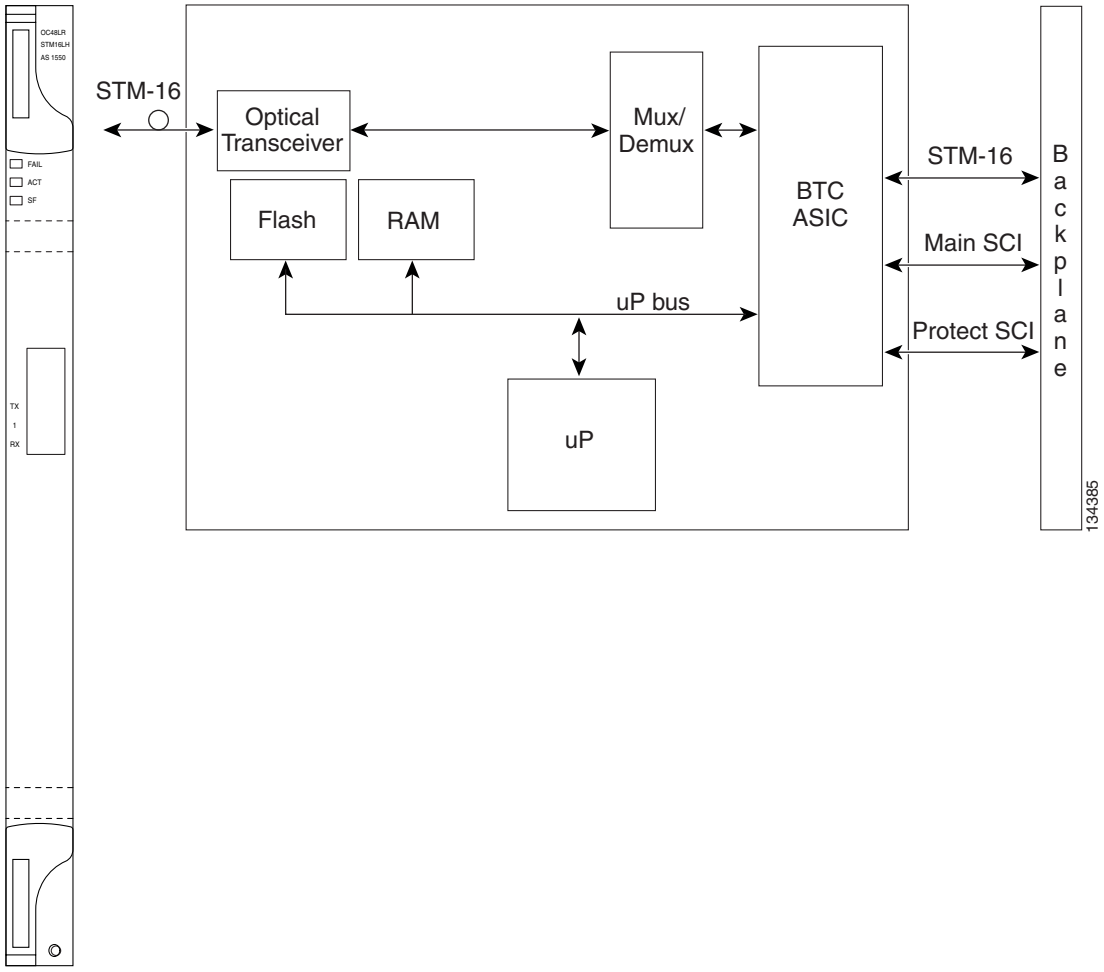
Note Any new features that are available as part of this software release are not enabled for this card.

The OC48 LR/STM16 LH AS 1550 card provides one long-range, ITU-T G.707- and G.957-compliant, SDH STM-16 port per card. The interface operates at 2.488 Gbps over a single-mode fiber span. The card supports concatenated or nonconcatenated payloads at STM-1, STM-4, or STM-16 signal levels on a per VC-4 basis.

Warning **The laser is on when the optical card is booted. The port does not have to be in service for the laser to be on.**

Figure 4-8 shows the OC48 LR/STM16 LH AS 1550 faceplate and block diagram.

Figure 4-8 OC48 LR/STM16 LH AS 1550 Faceplate and Block Diagram



4.9.1 OC48 LR/STM16 LH AS 1550 Card Functionality

You can install OC48 LR/STM16 LH AS 1550 cards in Slots 1 to 6 or 12 to 17. You can provision this card as part of a MS-SPRing or SNCP. In an LMSP configuration, you can provision the card as either an access tributary or a transport span interface.

The OC48 LR/STM16 LH AS 1550 port features a 1550-nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses SC connectors, and it supports 1+1 unidirectional protection and provisionable bidirectional and unidirectional switching.

The OC48 LR/STM16 LH AS 1550 detects LOS, LOF, LOP, MS-AIS, and MS-FERF conditions. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors.

4.9.2 OC48 LR/STM16 LH AS 1550 Card-Level Indicators

Table 4-10 describes the three card-level LED indicators on the OC48 LR/STM16 LH AS 1550 card.

Table 4-10 OC48 LR/STM16 LH AS 1550 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card processor is not ready. The FAIL LED is on during reset and flashes during the boot process. Replace the card if the red FAIL LED persists.
Green/Amber ACT LED	The green ACT LED indicates that the card is carrying traffic or is traffic-ready. The amber ACT LED indicates that the card is in standby mode or is part of an active ring switch (MS-SPRing).
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, or high BERs on one or more card ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.9.3 OC48 LR/STM16 LH AS 1550 Port-Level Indicators

You can find the status of the OC48 LR/STM16 LH AS 1550 card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.10 OC48 ELR/STM16 EH 100 GHz Cards

Note For specifications, see the "A.6.9 OC48 ELR/STM16 EH 100 GHz Card Specifications" section on page A-35.

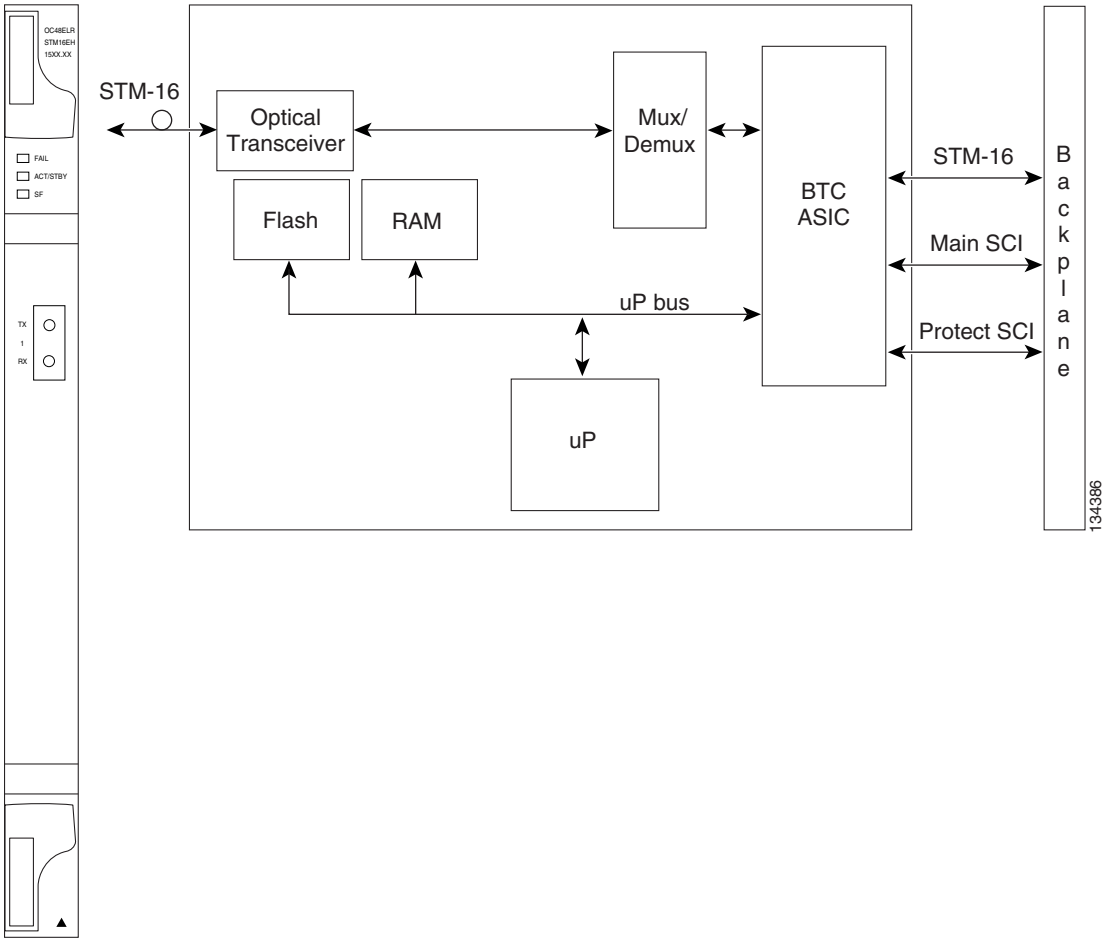
Eighteen distinct STM-16 ITU 100-GHz DWDM cards comprise the ONS 15454 SDH DWDM channel plan. This plan contains every second wavelength in the ITU grid for 100-GHz-spaced DWDM. Though the ONS 15454 SDH only uses 200-GHz spacing, the cards work in 100-GHz-spaced nodes, as well.

Each OC48 ELR/STM16 EH 100 GHz card provides one SDH STM-16 port compliant with ITU-T G.692, ITU-T G.707, ITU-T G.957, and ITU-T G.958. The interface operates at 2.488 Gbps over a single-mode fiber span. Each card supports concatenated or nonconcatenated payloads at STM-1, STM-4, or STM-16 signal levels on a per VC-4 basis.

Warning **The laser is on when the optical card is booted. The port does not have to be in service for the laser to be on.**

Figure 4-9 shows the OC48 ELR/STM16 EH 100 GHz faceplate and block diagram.

Figure 4-9 OC48 ELR/STM16 EH 100 GHz Faceplate and Block Diagram



4.10.1 OC48 ELR/STM16 EH 100 GHz Card Functionality

You can install OC48 ELR/STM16 EH 100 GHz cards in Slot 5, 6, 12, and 13. You can provision this card as part of a MS-SPRing or SNCP. In an ADM/TM configuration, you can provision the card as either an access tributary or a transport span interface.

Nine of the 18 available cards operate in the blue band with a spacing of 2 * 100 GHz in the ITU grid (1530.33 nm, 1531.90 nm, 1533.47 nm, 1535.04 nm, 1536.61 nm, 1538.19 nm, 1539.77 nm, 1541.35 nm, and 1542.94 nm). The other nine cards operate in the red band with a spacing of 2 * 100 GHz in the ITU grid (1547.72 nm, 1549.32 nm, 1550.92 nm, 1552.52 nm, 1554.13 nm, 1555.75 nm, 1557.36 nm, 1558.98 nm, and 1560.61 nm).

Each OC48 ELR/STM16 EH 100 GHz card uses extended long-reach optics operating individually within the ITU 100-GHz grid. The OC48 ELR/STM16 EH 100 GHz cards are intended to be used in applications with long unregenerated spans of up to 200 km (with mid-span amplification). These

transmission distances are achieved through the use of inexpensive optical amplifiers (flat gain amplifiers) such as erbium-doped fiber amplifiers (EDFAs). Using collocated amplification, distances up to 200 km can be achieved for a single channel (160 km for 8 channels).

Maximum system reach in filterless applications is 24 dB, or approximately 80 km, without the use of optical amplifiers or regenerators. However, system reach also depends on the condition of the facilities, number of splices and connectors, and other performance-affecting factors. The OC48 ELR/STM16 EH 100 GHz cards feature wavelength stability of +/– 0.25 nm. Each port contains a transmitter and a receiver.

The OC48 ELR/STM16 EH 100 GHz cards are the first in a family of cards meant to support extended long-reach applications in conjunction with optical amplification. Using DFB laser technology, the OC48 ELR/STM16 EH 100 GHz cards provide a solution at the lower extended long-reach distances.

The OC48 ELR/STM16 EH 100 GHz port features a 1550-nm range laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses SC connectors and supports 1+1 unidirectional and bidirectional protection switching.

The OC48 ELR/STM16 EH 100 GHz cards detect LOS, LOF, LOP, MS-AIS, and MS-FERF conditions. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The cards also count section and line BIP errors.

To enable an MS-SPRing, the OC48 ELR/STM16 EH 100 GHz cards extract the K1 and K2 bytes from the SDH overhead. The GCC bytes are forwarded to the TCC2/TCC2P card; the TCC2/TCC2P terminates the GCC.

4.10.2 OC48 ELR/STM16 EH 100 GHz Card-Level Indicators

Table 4-11 describes the three card-level LED indicators on the OC48 ELR/STM16 EH 100 GHz cards.

Table 4-11 OC48 ELR Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card processor is not ready. The FAIL LED is on during reset and flashes during the boot process. Replace the card if the red FAIL LED persists.
Green/Amber ACT LED	The green ACT LED indicates that the card is carrying traffic or is traffic-ready. The amber ACT LED indicates that the card is in standby mode or is part of an active ring switch (MS-SPRing).
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, or high BERs on one or more card ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.10.3 OC48 ELR/STM16 EH 100 GHz Port-Level Indicators

You can find the status of the OC48 ELR/STM16 EH 100 GHz card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.11 OC192 SR/STM64 IO 1310 Card

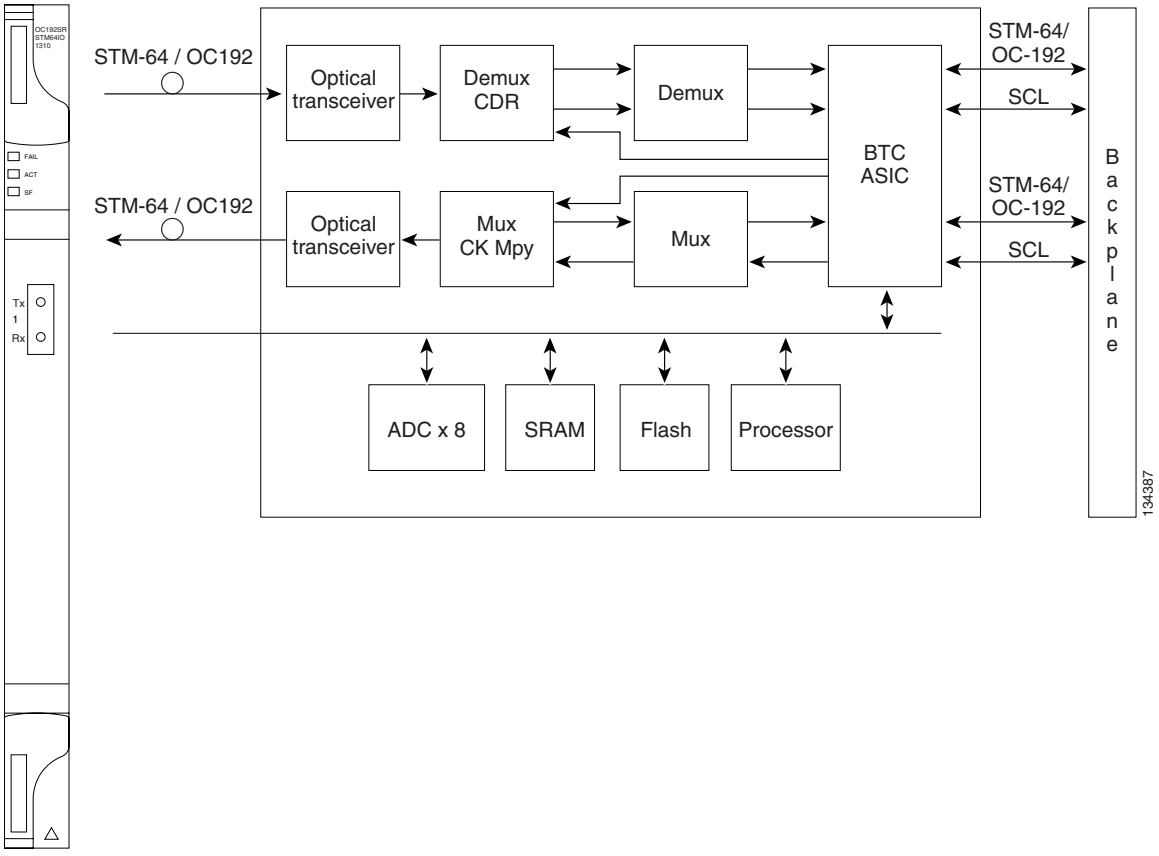
Note For specifications, see the "A.6.10 OC192 SR/STM64 IO 1310 Card Specifications" section on page A-37.

The OC192 SR/STM64 IO 1310 card provides one intra-office haul, ITU-T G.707- and G.957-compliant, SDH STM-64 port per card in the 1310-nm wavelength range. The port operates at 9.95328 Gbps over unamplified distances up to 2 km (1.24 miles). The card supports concatenated or nonconcatenated payloads on a VC-4 basis, as well as VC-4, VC-3, and VC-12 payloads. Figure 4-10 shows the OC192 SR/STM64 IO 1310 faceplate and block diagram.

Note The optics thresholds for this card are not retained after it is reset. As a result, the optics thresholds must be configured every time this card is reset, or any time the TCC/TCC2 card is reset. See DLP-D109 in the *Cisco ONS 15454 SDH Procedure Guide, R7.0* for instructions on setting the optics thresholds.

Warning **The laser is on when the optical card is booted. The port does not have to be in service for the laser to be on.**

Figure 4-10 OC192 SR/STM64 IO 1310 Faceplate and Block Diagram



4.11.1 OC192 SR/STM64 IO 1310 Card Functionality

You can install OC192 SR/STM64 IO 1310 cards in Slot 5, 6, 12, or 13. You can provision this card as part of an MS-SPRing, a SNCP, a linear configuration, or a regenerator for longer span reaches.

The OC192 SR/STM64 IO 1310 port features a 1310-nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses a dual SC connector for optical cable termination. The card supports 1+1 unidirectional and bidirectional facility protection. It also supports both span and ring switching in MS-SPRing protection scheme.

The OC192 SR/STM64 IO 1310 card detects SF, LOS, or LOF conditions on the optical facility. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors from B1 and B2 byte registers in the section and line overhead.

4.11.2 OC192 SR/STM64 IO 1310 Card-Level Indicators

Table 4-12 describes the three card-level LED indicators on the OC192 SR/STM64 IO 1310 card.

Table 4-12 OC192 SR/STM64 IO 1310 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card processor is not ready. The FAIL LED is on during reset and flashes during the boot process. Replace the card if the red FAIL LED persists.
ACT/STBY LED Green (Active) Amber (Standby)	If the ACT/STBY LED is green, the card is operational and ready to carry traffic. The amber ACT LED indicates that the card is in standby mode or is part of an active ring switch (MS-SPRing).
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, or high BERs on one or more card ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.11.3 OC192 SR/STM64 IO 1310 Port-Level Indicators

You can find the status of the OC192 SR/STM64 IO 1310 card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.12 OC192 IR/STM64 SH 1550 Card

Note For specifications, see the "A.6.11 OC192 IR/STM64 SH 1550 Card Specifications" section on page A-38.

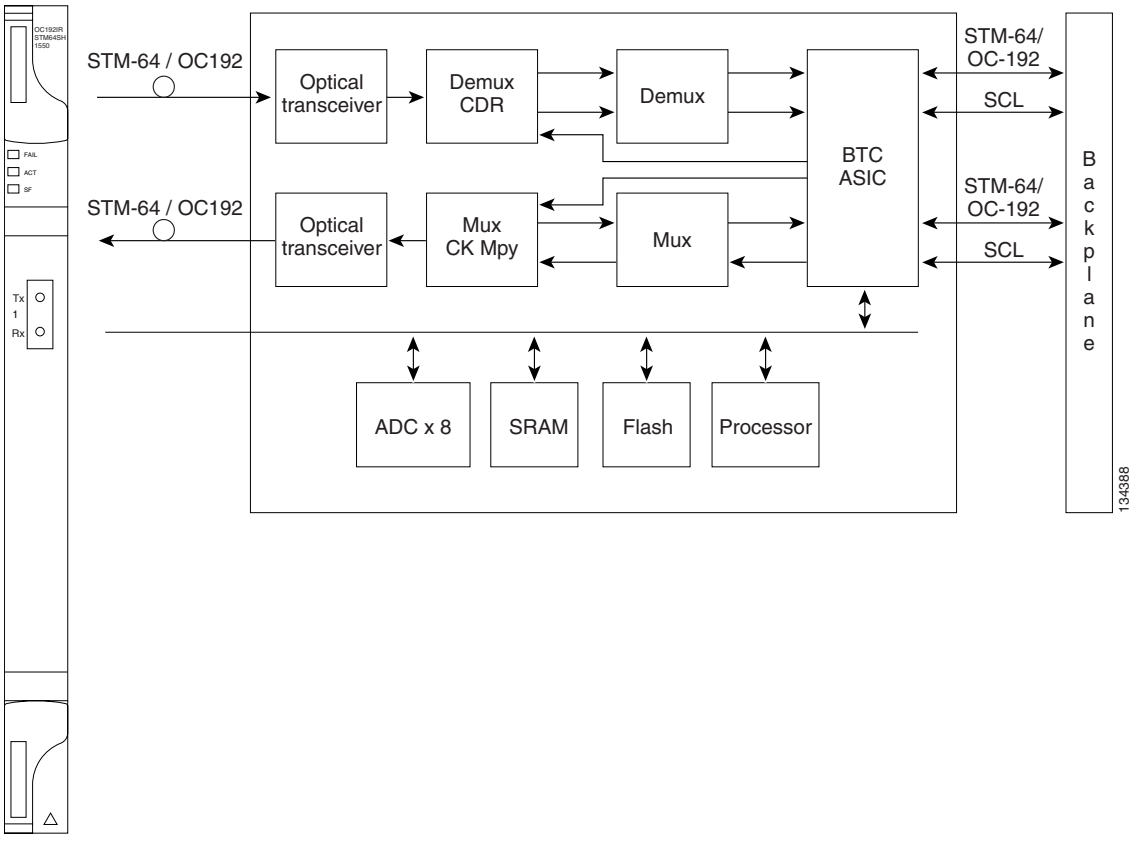
The OC192 IR/STM64 SH 1550 card provides one short-range, ITU-T G.707- and G.957-compliant, SDH STM-64 port per card. The port operates at 9.95328 Gbps over unamplified distances up to 40 km with SMF-28 fiber limited by loss and/or dispersion. The card supports concatenated or nonconcatenated payloads on a VC-4 basis, as well as VC-4, VC-3, and VC-12 payloads.

Caution You must use a 3 to 15 dB fiber attenuator (5 dB recommended) when working with the OC192 IR/STM64 SH 1550 card in a loopback. Do not use fiber loopbacks with the OC192 IR/STM64 SH 1550 card. Using fiber loopbacks can cause irreparable damage to the OC192 IR/STM64 SH 1550 card.

Warning **The laser is on when the optical card is booted. The port does not have to be in service for the laser to be on.**

Figure 4-11 shows the OC192 IR/STM64 SH 1550 faceplate and block diagram.

Figure 4-11 OC192 IR/STM64 SH 1550 Faceplate and Block Diagram



4.12.1 OC192 IR/STM64 SH 1550 Card Functionality

You can install OC192 IR/STM64 SH 1550 cards in Slot 5, 6, 12, or 13. You can provision this card as part of an MS-SPRing, SNCP, or linear configuration, or as a regenerator for longer span reaches.

The OC192 IR/STM64 SH 1550 port features a 1550-nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses a dual SC connector for optical cable termination. The card supports 1+1 unidirectional and bidirectional facility protection. It also supports 1:1 protection in four-fiber bidirectional line switched ring applications where both span switching and ring switching might occur.

The OC192 IR/STM64 SH 1550 card detects SF, LOS, or LOF conditions on the optical facility. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors from B1 and B2 byte registers in the section and line overhead.

4.12.2 OC192 IR/STM64 SH 1550 Card-Level Indicators

Table 4-13 describes the three card-level LED indicators on the OC192 IR/STM64 SH 1550 card.

Table 4-13 OC192 IR/STM64 SH 1550 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card processor is not ready. The FAIL LED is on during reset and flashes during the boot process. Replace the card if the red FAIL LED persists.
ACT/STBY LED Green (Active) Amber (Standby)	If the ACT/STBY LED is green, the card is operational and ready to carry traffic. The amber ACT/STBY LED indicates that the card is in standby mode or is part of an active ring switch (MS-SPRing).
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, or high BERs on one or more card ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.12.3 OC192 IR/STM64 SH 1550 Port-Level Indicators

You can find the status of the OC192 IR/STM64 SH 1550 card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.13 OC192 LR/STM64 LH 1550 Card

Note For specifications, see the "A.6.12 OC192 LR/STM64 LH 1550 Card Specifications" section on page A-39.

Note Any new features that are available as part of this software release are not enabled for this card.

The OC192 LR/STM64 LH 1550 card provides one long-range SDH STM-64 port per card, compliant with ITU-T G.707 and G.957, and Telcordia GR-253-CORE (except minimum and maximum transmit power, and minimum receive power). Also, the port is compliant to ITU-T G.691 (prepublished unedited version 10/2000) L-64.2, except for optical output power and receiver sensitivity.

Note The optical output power of the OC192 LR/STM64 LH 1550 (+4 dBm to +7 dBm) is 6 dB lower than in L-64.2b of the 10/2000 prepublished unedited version of ITU-T G.691 (+10 dBm to +13 dBm). However, the total attenuation range of the optical path, 22 to 16 dB, is maintained by the optical receiver sensitivity range of the OC192 LR/STM64 LH 1550 (–7 dBm to –24 dBm). This sensitivity range outperforms the specification in L-64.2b of the 10/2000 prepublished unedited version of ITU-T G.691 as the resulting link budget of the card is 26 dBm.

The port operates at 9.95328 Gbps over unamplified distances up to 80 km with different types of fiber such as C-SMF or dispersion compensated fiber limited by loss and/or dispersion. The card supports concatenated or nonconcatenated payloads on a VC-4 basis, as well as VC-4, VC-3, and VC-12 payloads.

Figure 4-12 shows the OC192 LR/STM64 LH 1550 faceplate and a block diagram of the card. Figure 4-13 on page 4-29 shows an enlarged view of the faceplate warning.

Note You can differentiate this OC-192/STM-64 card (15454E-L64.2-1) from the OC-192/STM-64 card with the product ID 15454-OC192LR1550 by looking at the faceplate. This card does not have a laser on/off switch.

Note The optics thresholds for this card are not retained after it is reset. As a result, the optics thresholds must be configured every time this card is reset, or any time the TCC/TCC2 card is reset. See DLP-D109 in the *Cisco ONS 15454 SDH Procedure Guide, R7.0* for instructions on setting the optics thresholds.

Warning **The laser is on when the optical card is booted. The port does not have to be in service for the laser to be on.**

Figure 4-12 OC192 LR/STM64 LH 1550 Faceplate and Block Diagram

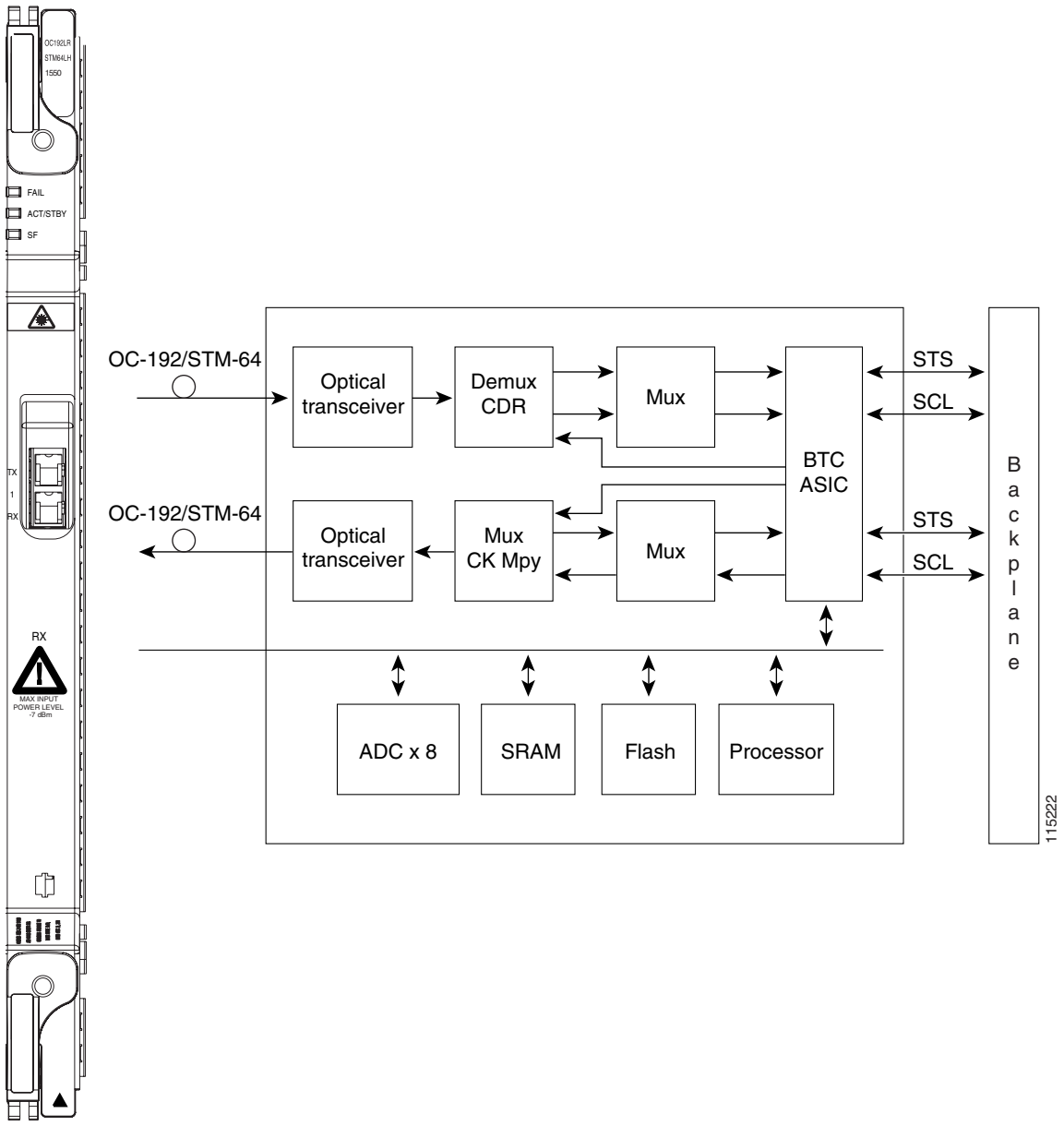
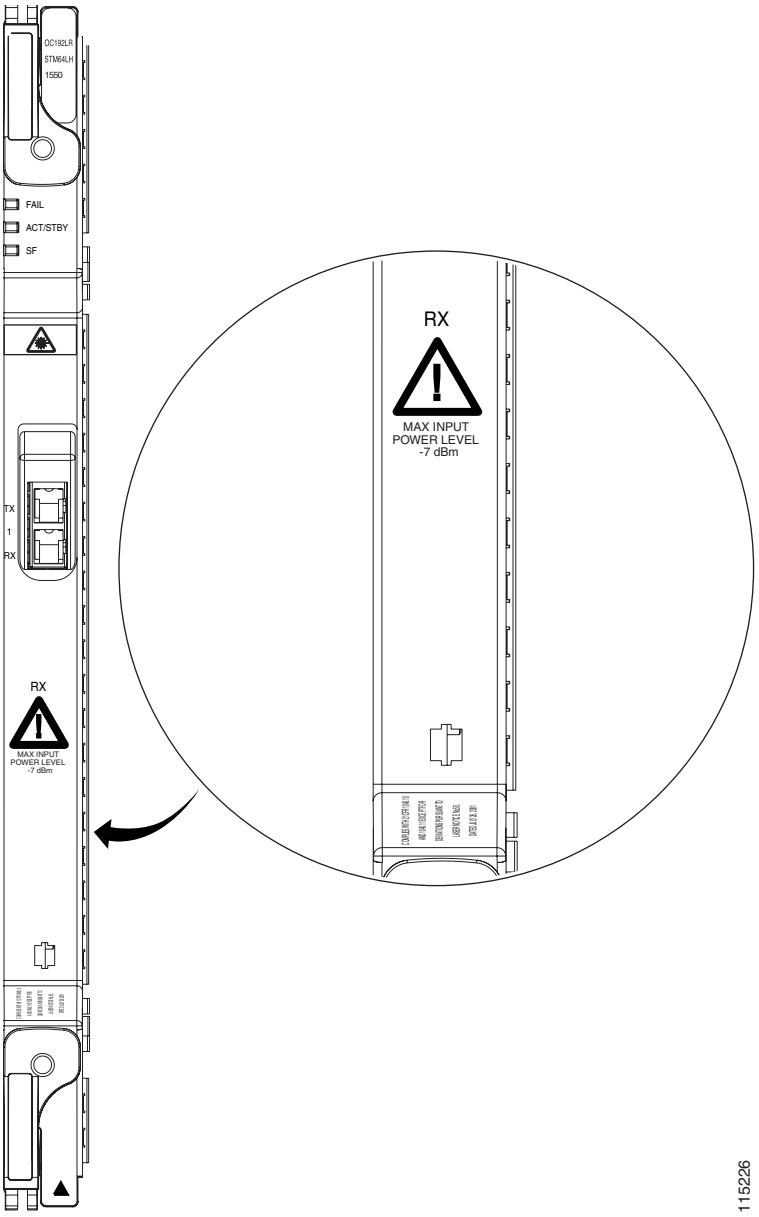


Figure 4-13 Enlarged Section of the OC192 LR/STM64 LH 1550 Faceplate



4.13.1 OC192 LR/STM64 LH 1550 Card Functionality

You can install OC192 LR/STM64 LH 1550 cards in Slot 5, 6, 12, or 13. You can provision this card as part of an MS-SPRing, SNCP, or linear configuration, or also as a regenerator for longer span reaches.

The OC192 LR/STM64 LH 1550 port features a 1550-nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses a dual SC connector for optical cable termination. The card supports 1+1 unidirectional and bidirectional facility protection. It also supports 1:1 protection in four-fiber bidirectional line switched ring applications where both span switching and ring switching might occur.

The OC192 LR/STM64 LH 1550 card detects SF, LOS, or LOF conditions on the optical facility. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors from B1 and B2 byte registers in the section and line overhead.

Caution You must use a 20-dB fiber attenuator (19 to 24 dB) when working with the OC192 LR/STM64 LH 1550 card in a loopback. Do not use fiber loopbacks with the OC192 LR/STM64 LH 1550 card. Using fiber loopbacks causes irreparable damage to the OC192 LR/STM64 LH 1550 card.

4.13.2 OC192 LR/STM64 LH 1550 Card-Level Indicators

Table 4-14 describes the three card-level LED indicators on the OC192 LR/STM64 LH 1550 card.

Table 4-14 OC192 LR/STM64 LH 1550 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card processor is not ready. The FAIL LED is on during reset and flashes during the boot process. Replace the card if the red FAIL LED persists.
ACT/STBY LED Green (Active) Amber (Standby)	If the ACT/STBY LED is green, the card is operational and ready to carry traffic. If the ACT/STBY LED is amber, the card is in standby mode or is part of an active ring switch (MS-SPRing).
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, or high BERs on one or more card ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.13.3 OC192 LR/STM64 LH 1550 Port-Level Indicators

You can find the status of the OC192 LR/STM64 LH 1550 card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.14 OC192 LR/STM64 LH ITU 15xx.xx Card

Note For specifications, see the "A.6.13 OC192 LR/STM64 LH ITU 15xx.xx Card Specifications" section on page A-40.

Sixteen distinct STM-64 ITU 100 GHz DWDM cards comprise the ONS 15454 SDH DWDM channel plan. The OC192 LR/STM64 LH ITU 15xx.xx card provides one long-range SDH STM-64 port per card, compliant with ITU-T G.707 and G.957, and Telcordia GR-253-CORE (except minimum and maximum transmit power, and minimum receive power). The port operates at 9.95328 Gbps over unamplified distances up to 60 km with different types of fiber such as C-SMF or dispersion compensated fiber limited by loss and/or dispersion.

Note Longer distances are possible in an amplified system using dispersion compensation.

Note The optics thresholds for this card are not retained after it is reset. As a result, the optics thresholds must be configured every time this card is reset, or any time the TCC/TCC2 card is reset. See DLP-D109 in the *Cisco ONS 15454 SDH Procedure Guide, R7.0* for instructions on setting the optics thresholds.

Warning **The laser is on when the optical card is booted. The port does not have to be in service for the laser to be on.**

The card supports concatenated or nonconcatenated payloads on a VC-4 basis, as well as VC-4, VC-3, and VC-12 payloads. Figure 4-14 shows the OC192 LR/STM64 LH ITU 15xx.xx faceplate.

Figure 4-14 OC192 LR/STM64 LH ITU 15xx.xx Faceplate

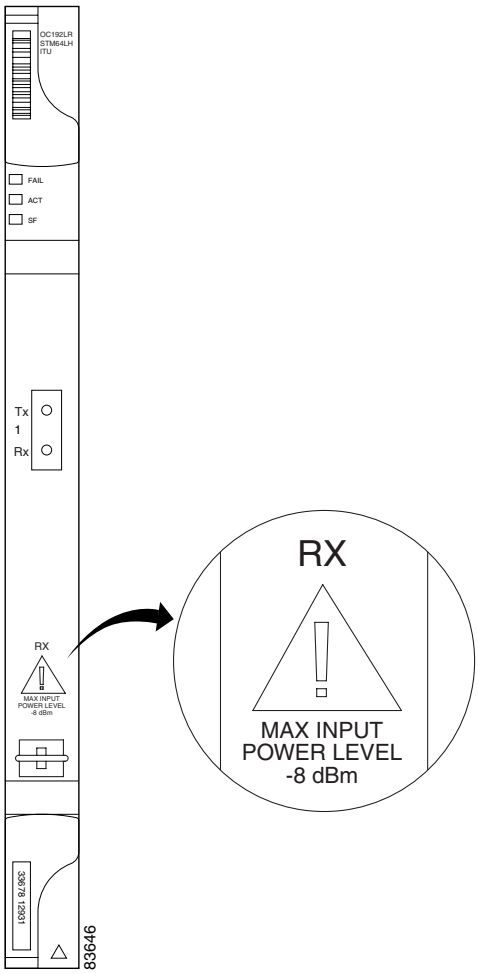
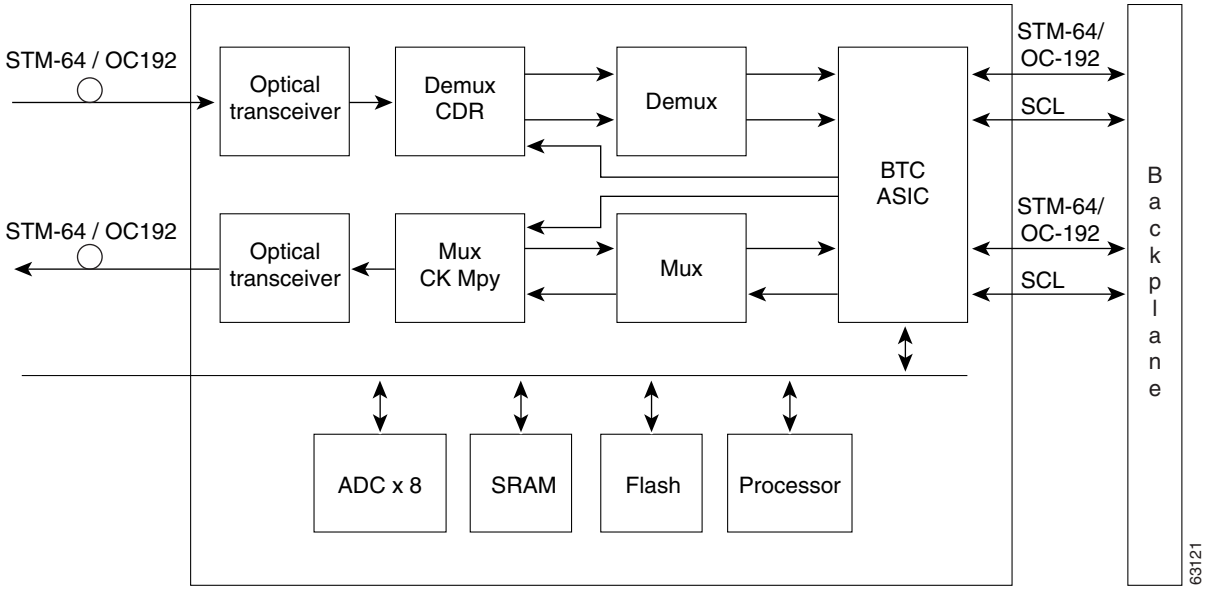


Figure 4-15 on page 4-32 shows a block diagram of the card.

Figure 4-15 OC192 LR/STM64 LH ITU 15xx.xx Block Diagram



4.14.1 OC192 LR/STM64 LH ITU 15xx.xx Card Functionality

You can install OC192 LR/STM64 LH ITU 15xx.xx cards in Slot 5, 6, 12, or 13. You can provision this card as part of an MS-SPRing, SNCP, or linear configuration, or as a regenerator for longer span reaches.

Eight of the available 16 OC192 LR/STM64 LH ITU 15xx.xx cards operate in the blue band with a spacing of 100 GHz in the ITU grid (1534.25 nm, 1535.04 nm, 1535.82 nm, 1536.61 nm, 1538.19 nm, 1538.98 nm, 1539.77 nm, and 1540.56 nm). The other eight cards operate in the red band with a spacing of 100 GHz in the ITU grid (1550.12 nm, 1550.92 nm, 1551.72 nm, 1552.52 nm, 1554.13 nm, 1554.94 nm, 1555.75 nm, and 1556.55 nm).

The OC192 LR/STM64 LH ITU 15xx.xx port features a laser on a specific wavelength in the 1550-nm range and contains a transmit and receive connector (labeled) on the card faceplate. The card uses a dual SC connector for optical cable termination. The card supports 1+1 unidirectional and bidirectional facility protection. It also supports both span and ring switching in MS-SPRing protection scheme.

The OC192 LR/STM64 LH ITU 15xx.xx card detects SF, LOS, or LOF conditions on the optical facility. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors from B1 and B2 byte registers in the section and line overhead.

4.14.2 OC192 LR/STM64 LH ITU 15xx.xx Card-Level Indicators

Table 4-15 describes the three card-level LED indicators on the OC192 LR/STM64 LH ITU 15xx.xx card.

Table 4-15 OC192 LR/STM64 LH ITU 15xx.xx Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card processor is not ready. The FAIL LED is on during reset and flashes during the boot process. Replace the card if the red FAIL LED persists.
ACT/STBY LED Green (Active) Amber (Standby)	If the ACT/STBY LED is green, the card is operational and ready to carry traffic. If the ACT/STBY LED is amber, the card is in standby mode or is part of an active ring switch (MS-SPRing).
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, or high BERs on one or more card ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.14.3 OC192 LR/STM64 LH ITU 15xx.xx Port-Level Indicators

You can find the status of the OC192 LR/STM64 LH ITU 15xx.xx card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.15 15454_MRC-12 Multirate Card

Note For specifications, see the "A.6.14 15454_MRC-12 Card Specifications" section on page A-41.

The 15454_MRC-12 multirate card provides up to twelve OC-3/STM-1 ports, twelve OC-12/STM-4 ports, or four OC-48/STM-16 ports using Small Form-factor Pluggables (SFPs), in any combination of line rates. All ports are Telcordia GR-253 compliant. The SFP optics can use SR, IR, LR, coarse wavelength division multiplexing (CWDM), and DWDM SFPs to support unrepeated spans. See the "4.17 SFPs and XFPs" section on page 4-40 for more information about SFPs.

The ports operate at up to 2488.320 Mbps over a single-mode fiber. The 15454_MRC-12 card has twelve physical connector adapters with two fibers per connector adapter (Tx and Rx). The card supports VT payloads,VC4 payloads, and concatenated payloads at VC4-1c, VC4-2c, VC4-3c, VC4-4c, VC4-8c, or VC4-16c signal levels. It is fully interoperable with the ONS 15454 SDH G-Series Ethernet cards.

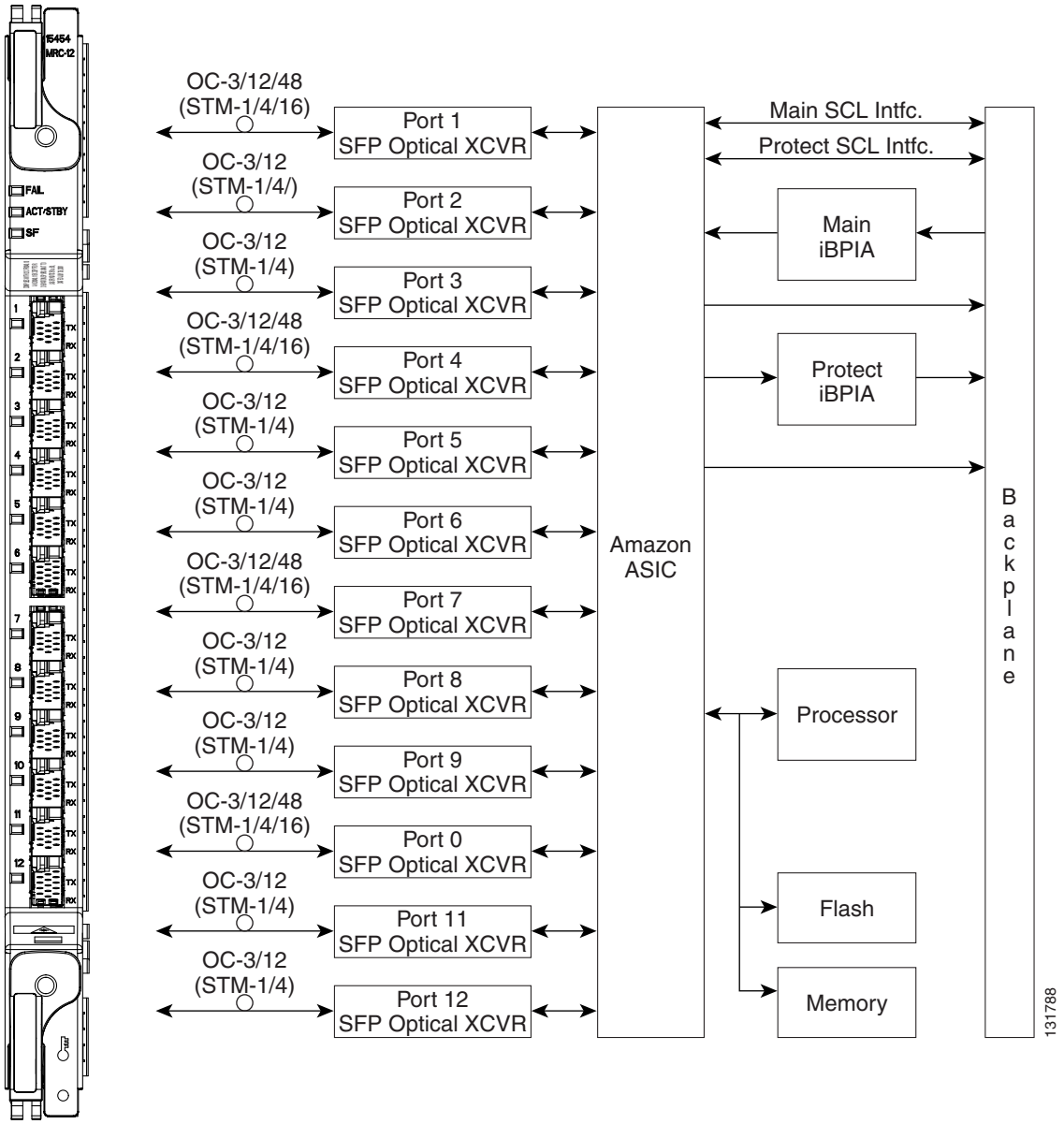
Each 15454_MRC-12 port contains a transmit and receive connector (labeled) on the card faceplate. The card supports unidirectional and bidirectional facility protection.It also supports both span and ring switching in MS-SPRing protection scheme. You can provision this card as part of an MS-SPRing, SNCP, or linear configuration.

Note Longer distances are possible in an amplified system using dispersion compensation.

Note Refer to Table 4-2 on page 4-4 for information on optical card compatibility.

Figure 4-16 shows the 15454_MRC-12 faceplate and block diagram.

Figure 4-16 15454_MRC-12 Card Faceplate and Block Diagram



4.15.1 Slot Compatibility by Cross-Connect Card

You can install 15454_MRC-12 cards in Slots 1 through 6 and 12 through 17 with XC-VXL-2.5G, XC-VXL-10G, or XC-VXC-10G cards.

Note The 15454_MRC-12 card supports an errorless software-initiated cross-connect card switch when used in a shelf equipped with XC-VXC-10G and TCC2/TCC2P cards.

The maximum bandwidth of the 15454_MRC-12 card is determined by the cross-connect card, as shown in Table 4-16.

Table 4-16 Maximum Bandwidth by Shelf Slot for the 15454_MRC-12 in Different Cross-Connect Configurations

XC Card Type	Maximum Bandwidth in Slots 1 through 4 and 12 through 17	Maximum Bandwidth in Slots 5, 6, 12, or 13
XC-VXL-2.5G	STM-16	STM-16
XC-VXC-10G/XC-VXL-10G	STM-16	STM-64

4.15.2 Ports and Line Rates

Each port on the 15454_MRC-12 card can be configured as OC-3/STM-1, OC-12/STM-4, or OC-48/STM-16, depending on the available bandwidth and existing provisioned ports. Based on the cross-connect card and slot limitations shown in Table 4-16, the following rules apply for various synchronous transport signal (STS) available bandwidths. (Table 4-17 shows the same information in tabular format.)

- VC4-16
  - Port 1 is the only port usable as an STM-16. If Port 1 is used as an STM-16, all other ports are disabled.
  - Ports 1, 4, 7, and 10 are the only ports usable as STM-4.
  - If Port 4 is used as an STM-4, Ports 2 and 3 are disabled.
  - If Port 7 is used as an STM-4, Ports 5, 6, and 8 are disabled.
  - If Port 10 is used as an STM-4, Ports 9, 11, and 12 are disabled.
  - Any port can be used as an STM-1 as long as all of the above rules are followed.
- VC4-64
  - Ports 1, 4, 7, and 10 are the only ports usable as STM-16.
  - If Port 4 is used as an STM-16, Ports 2 and 3 are disabled.
  - If Port 7 is used as an STM-16, Ports 5, 6, and 8 are disabled.
  - If Port 10 is used as an STM-16, Ports 9, 11, and 12 are disabled.
  - If Port 4 is used as an STM-4, Ports 2 and 3 can be used as an STM-4 or STM-1.
  - If Port 7 is used as an STM-4, Ports 5, 6, and 8 can be used as an STM-4 or STM-1.
  - If Port 10 is as used as an STM-4, Ports 9, 11, and 12 can be used as an STM-4 or STM-1.

- If Port 4 is used as an STM-1, Ports 2 and 3 can be used as an STM-1 or STM-4.
- If Port 7 is used as an STM-1, Ports 5, 6, and 8 can be used as an STM-1 or STM-4.
- If Port 10 is used as an STM-1, Ports 9, 11, and 12 can be used as an STM-1 or STM-4.
- Any port can be used as an STM-4 or STM-1, as long as all of the above rules are followed.

Table 4-17 shows the 15454_MRC-12 port availability and line rate for each port, based on total available bandwidth. To use the table, go to the rows for the bandwidth that you have available, as determined in Table 4-16. Each row indicates what line rate can be provisioned for each port (identified in the MCR-12 Port Number row). The Ports Used column shows the total number of ports that can be used with each bandwidth scheme.

Table 4-17 Line Rate Configurations Per 15454_MRC-12 Port, Based on Available Bandwidth

MRC-12 Port Number	1	2	3	4	5	6	7	8	9	10	11	12	Ports Used	Total VC4s
Permitted Rate(s)	STM-1 STM-4 STM-16	STM-1 STM-4	STM-1 STM-4	STM-1 STM-4 STM-16	STM-1 STM-4	STM-1 STM-4	STM-1 STM-4 STM-16	STM-1 STM-4	STM-1 STM-4	STM-1 STM-4 STM-16	STM-1 STM-4	STM-1 STM-4	—	—
STM-16 Available Bandwidth	1	1	1	1	1	1	1	1	1	1	1	1	12	12
	1	—	—	4	1	1	1	1	1	1	1	1	10	13
	1	—	—	4	—	—	4	—	1	1	1	1	7	13
	1	—	—	4	—	—	4	—	—	4	—	—	4	13
	4	1	1	1	1	1	1	1	1	1	1	1	12	15
	4	—	—	4	1	1	1	1	1	1	1	1	10	16
	4	—	—	4	—	—	4	—	1	1	1	1	7	16
	4	—	—	4	—	—	4	—	—	4	—	—	4	16
	4	1	1	1	—	—	4	—	1	1	1	1	9	15
	4	1	1	1	1	1	1	1	—	4	—	—	9	15
	1	1	1	1	1	1	1	1	—	4	—	—	9	12
	1	1	1	1	—	—	4	—	—	4	—	—	6	12
	16	—	—	—	—	—	—	—	—	—	—	—	1	16

Table 4-17 Line Rate Configurations Per 15454_MRC-12 Port, Based on Available Bandwidth (continued)

MRC-12 Port Number	1	2	3	4	5	6	7	8	9	10	11	12	Ports Used	Total VC4s
STM-64 Available Bandwidth (when installing additional SFPs from the top port to the bottom port)[1]	16	1	1	1	1	1	1	1	1	1	1	1	12	27
	16	4	4	4	1	1	1	1	1	1	1	1	12	36
	16	4	4	4	4	4	4	4	1	1	1	1	12	48
	16	4	4	4	4	4	4	4	4	4	4	4	12	60
	16	1	1	1	4	4	4	4	4	4	4	4	12	51
	16	1	1	1	1	1	1	1	4	4	4	4	12	39
	16	—	—	16	1	1	1	1	1	1	1	1	10	40
	16	—	—	16	4	4	4	4	1	1	1	1	10	52
	16	—	—	16	4	4	4	4	4	4	4	4	10	64
	16	—	—	16	—	—	16	—	1	1	1	1	7	52
	16	—	—	16	—	—	16	—	4	4	4	4	7	64
	16	—	—	16	—	—	16	—	—	16	—	—	4	64
STM-64 Available Bandwidth (when installing additional SFPs from the bottom port to the top port)[1]	1	1	1	1	1	1	1	1	—	16	—	—	9	24
	1	1	1	1	4	4	4	4	—	16	—	—	9	36
	1	4	4	4	4	4	4	4	—	16	—	—	9	45
	4	4	4	4	4	4	4	4	—	16	—	—	9	48
	4	4	4	4	1	1	1	1	—	16	—	—	9	36
	4	1	1	1	1	1	1	1	—	16	—	—	9	27
	1	1	1	1	—	—	16	—	—	16	—	—	6	36
	1	4	4	4	—	—	16	—	—	16	—	—	6	45
	4	4	4	4	—	—	16	—	—	16	—	—	6	48
	4	1	1	1	—	—	16	—	—	16	—	—	6	39
	1	—	—	16	—	—	16	—	—	16	—	—	4	49
	4	—	—	16	—	—	16	—	—	16	—	—	4	52

1. If the MRC-12 card is initially populated with STM-1/STM-4 on all its 12 ports, you can later add STM-16 SFPs on that card frm top port to bottom port or from bottom port to top port. The maximum available bandwidth usage is different for these two cases.

4.15.3 15454_MRC-12 Card-Level Indicators

Table 4-18 describes the three card-level LEDs on the 15454_MRC-12 card.

Table 4-18 15454_MRC-12 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card processor is not ready. This LED is on during reset. The FAIL LED flashes during the boot process. Replace the card if the red FAIL LED persists.
ACT/STBY LED Green (Active) Amber (Standby)	If the ACT/STBY LED is green, the card is operational and ready to carry traffic. If the ACT/STBY LED is amber, the card is operational and in standby (protect) mode or is part of an active ring switch (MS-SPRing).
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, or high BERs on one or more card ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.15.4 15454_MRC-12 Port-Level Indicators

Each port has an Rx indicator. The LED flashes green if the port is receiving a signal, and it flashes red if the port is not receiving a signal.

You can also find the status of the 15454_MRC-12 card ports by using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.16 OC192SR1/STM64IO Short Reach and OC192/STM64 Any Reach Cards

Note For specifications, see the "A.6.15 OC192SR1/STM64IO Short Reach Card Specifications" section on page A-42.

The OC192SR1/STM64IO Short Reach and OC192/STM64 Any Reach cards (also known in CTC as STM64-XFP) each provide a single OC-192/STM-64 interface, as follows:

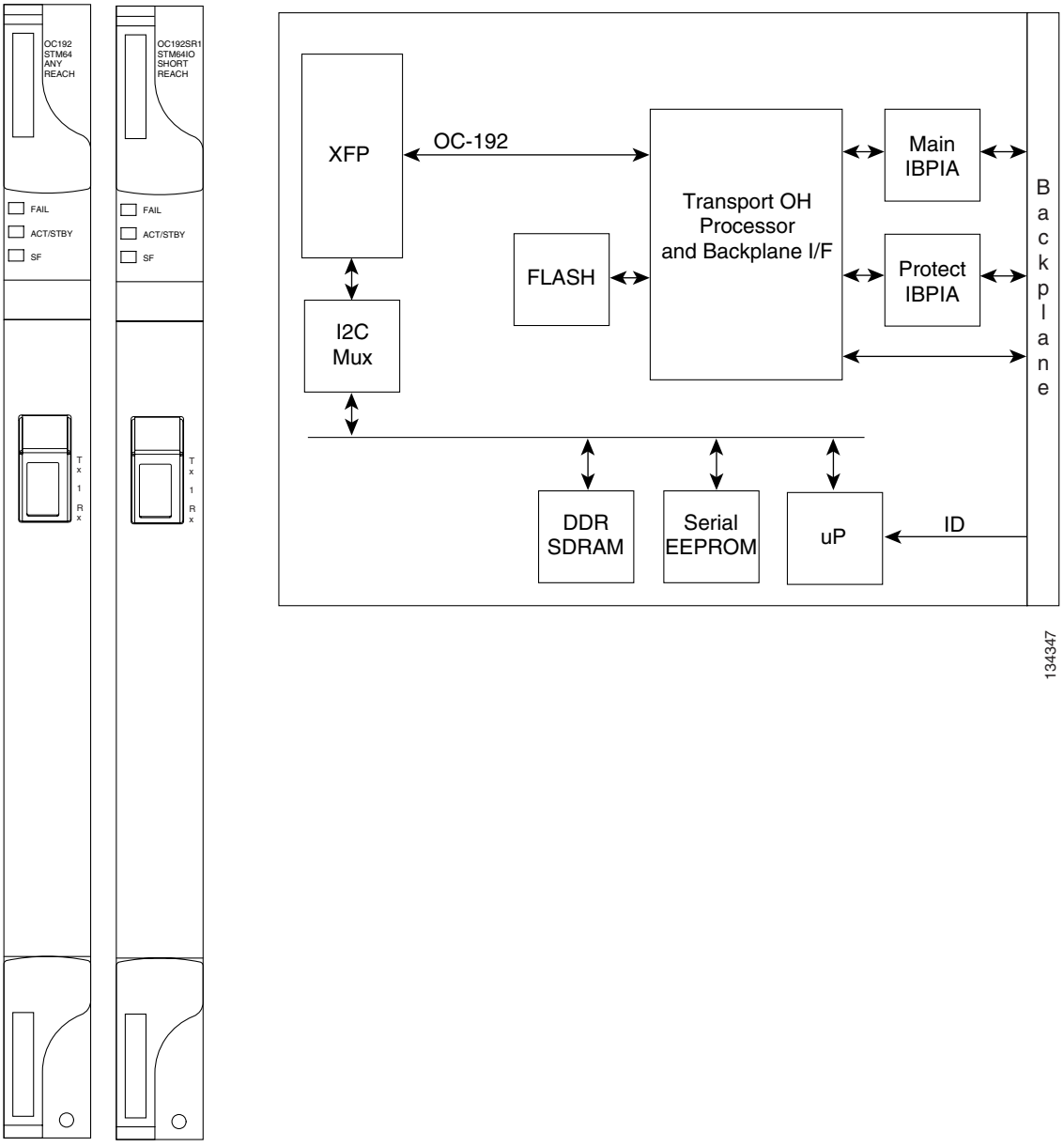
- OC192SR1/STM64IO Short Reach card (SR-1)
- OC192/STM64 Any Reach card (SR-1, IR-2, and LR-2)

The interface operates at 9.952 Gbps over single-mode fiber spans and may be provisioned for both concatenated and non-concatenated payloads on a per VC-4/STS-1 basis. Specifications references can be found for the OC-192/STM-64 interface in ITU-T G.691, G.693, and G.959.1 as well as Telcordia GR-253.

The optical interface uses a 10 Gbps Form Factor Pluggable (XFP) optical transceiver that plugs into a receptacle on the front of the card. The OC192/STM-64 SR-1 Short Reach card is used only with an SR-1 XFP, while the OC192/STM-64 Any Reach card can be provisioned for use with an SR-1, IR-2, or LR-2 XFP module. The XFP SR, IR, and LR interfaces each provide one bidirectional OC192/STM64 interface compliant with the recommendations defined by ITU-T G6.91.SR-1 is compliant with I-64.1, IR-2 is compliant with S-64.2b, and LR-2 is compliant with P1L1-2D2.

The cards are used in Slots 5, 6, 12, and 13 and only with 10 Gbps cross-connect cards, such as the XC-VXL-10G and XC-VXC-10G. The cards also must be supported with the TCC2 or TCC2P cards. Figure 4-17 shows the faceplates and block diagram for the two cards.

Figure 4-17 OC192SR1/STM64IO Short Reach and OC192/STM64 Any Reach Card Faceplates and Block Diagram



The cards have spans according to the XFP module used:

- A card using the SR-1 XFP is intended to be used in applications requiring 10 Gbps transport with unregenerated spans of up to 2.0 km.
- A card using the IR-2 XFP is intended to be used in applications requiring 10 Gbps transport with unregenerated spans of up to 40 km.

- A card using the LR-2 XFP is intended to be used in applications requiring 10 Gbps transport with unregenerated spans of up to 80 km.

4.16.1 OC192SR1/STM64IO Short Reach and OC192/STM64 Any Reach Card-Level Indicators

Table 4-19 describes the three card-level LEDs on the OC-192/STM-64 cards.

Table 4-19 OC192SR1/STM64IO Short Reach and OC192/STM64 Any Reach Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card processor is not ready. This LED is on during reset. The FAIL LED flashes during the boot process. Replace the card if the red FAIL LED persists.
ACT/STBY LED Green (Active) Amber (Standby)	If the ACT/STBY LED is green, the card is operational and ready to carry traffic. If the ACT/STBY LED is amber, the card is operational and in standby (protect) mode or is part of an active ring switch (MS-SPRing).

4.16.2 OC192SR1/STM64IO Short Reach and OC192/STM64 Any Reach Port-Level Indicators

You can find the status of the OC192SR1/STM64IO Short Reach and OC192/STM64 Any Reach card ports using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the Cisco ONS 15454 Troubleshooting Guide for a complete description of the alarm messages.

4.17 SFPs and XFPs

Note For specifications, see the "A.2 SFP and XFP Specifications" section on page A-3.

The ONS 15454 Optical cards use industry standard small form-factor pluggable connectors (SFPs) and 10 Gbps (XFP) modular receptacles. This section describes SFPs and XFPs used with optical cards. Currently, the only optical cards that use SFPs and XFPs are the 15454_MRC-12, OC192SR1/STM64IO Short Reach, and OC192/STM64 Any Reach cards.

The type of SFP or XFP plugged into the card appears in CTC and TL1. Cisco offers SFPs as separate orderable products.

4.17.1 Compatibility by Card

Table 4-20 lists Cisco ONS 15454 optical cards with their compatible SFPs and XFPs.

Caution Only use SFPs certified for use in Cisco Optical Networking Systems. The qualified Cisco SFP and XFP pluggable module's top assembly numbers (TANs) are provided in Table 4-20.

Table 4-20 SFP and XFP Card Compatibility

Card	Compatible SFPs and XFPs (Cisco Product ID)	Cisco Top Assembly Number (TAN)
15454_MRC-12 (ONS 15454 SONET/SDH)	ONS-SI-2G-S1 ONS-SI-2G-I1 ONS-SI-2G-L1 ONS-SI-2G-L2 ONS-SC-2G-30.3 through ONS-SC-2G-60.6 ONS-SI-622-I1 ONS-SI-622-L1 ONS-SI-622-L2 ONS-SE-622-1470 through ONS-SE-622-1610 ONS-SI-155-I1 ONS-SI-155-L1 ONS-SI-155-L2 ONS_SE-155-1470 through ONS-SE-155-1610	10-1992-01 10-1993-01 10-2102-01 10-1990-01 10-2155-01 through 10-2186-01 10-1956-01 10-1958-01 10-1936-01 10-2004-01 through 10-2011-01 10-1938-01 10-1957-01 10-1937-01 10-1996-01 through 10-2003-01
OC192SR1/STM64IO Short Reach (ONS 15454 SONET/SDH)[1]	ONS-XC-10G-S1	10-2012-01
OC192/STM64 Any Reach (ONS 15454 SONET/SDH)[1]	ONS-XC-10G-S1 ONS-XC-10G-I2 ONS-XC-10G-L2	10-2012-01 10-2193-01 10-2194-01

1. CTC refers to this card as STM64-XFP

4.17.2 SFP Description

SFPs are integrated fiber optic transceivers that provide high speed serial links from a port or slot to the network. Various latching mechanisms are used on the modules. There is no correlation between the type of latch to the model type (such as SX or LX/LH) and the technology type (such as Gigabit Ethernet). See the label on the SFP for technology type and model. One type of latch available is a mylar tab (Figure 4-18), a second type of latch available is an actuator/button (Figure 4-19), and a third type of latch is a bail clasp (Figure 4-20).

SFP dimensions are:

- Height 0.03 in. (8.5 mm)
- Width 0.53 in. (13.4 mm)
- Depth 2.22 in. (56.5 mm)

SFP and XFP temperature ranges for are:

- COM—commercial operating temperature range -5•C to 70•C
- EXT—extended operating temperature range -5•C to 85•C

- IND—industrial operating temperature range -40•C to 85•C

Figure 4-18 Mylar Tab SFP

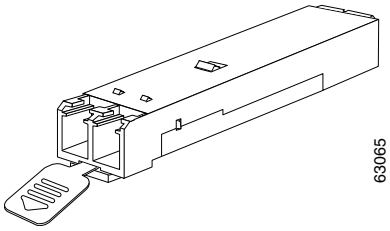


Figure 4-19 Actuator/Button SFP

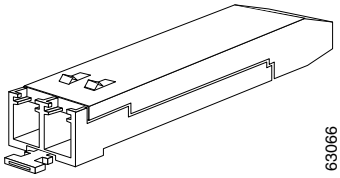
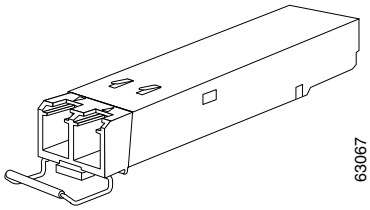


Figure 4-20 Bail Clasp SFP



4.17.3 XFP Description

The 10 Gbps 1310 nm and 1550 nm XFP transceivers are integrated fiber optic transceivers that provide high-speed serial links at the following signaling rates: 9.95 Gbps, 10.31 Gbps, and 10.51 Gbps. The XFP integrates the receiver and transmit path. The transmit side recovers and retimes the 10 Gbps serial data and passes it to a laser driver. The laser driver biases and modulates a 1310 nm or 1550 nm distributed feedback (DFB), enabling data transmission over SMF through an LC connector. The receive side recovers and retimes the 10 Gbps optical data stream from a PIN photo detector, transimpedance amplifier and passes it to an output driver.

The XFP module uses the bail clasp latching mechanism as shown unlatched in Figure 4-21 and latched in Figure 4-22. See the label on the XFP for technology type and model.

XFP dimensions are:

- Height 0.33 in. (8.5 mm)
- Width 0.72 in. (18.3 mm)
- Depth 3.1 in. (78 mm)

XFP temperature ranges are:

- COM—commercial operating temperature range -5•C to 70•C
- EXT—extended operating temperature range -5•C to 85•C
- IND—industrial operating temperature range -40•C to 85•C

Figure 4-21 Bail Clasp XFP (Unlatched)

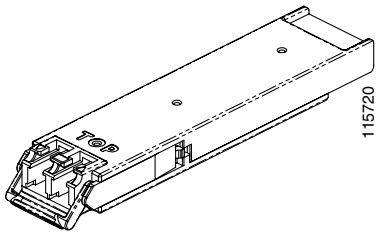
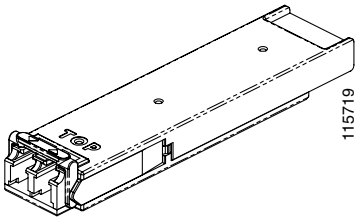


Figure 4-22 Bail Clasp XFP (Latched)



4.17.4 PPM Provisioning

SFPs and XFPs are known as pluggable-port modules (PPMs) in the ONS 15454 SDH graphical user interface (GUI), CTC. Multirate PPMs for the 15454_MRC-12 card can be provisioned for different line rates in CTC. For more information about provisioning PPMs, refer to the *Cisco ONS 15454 SDH Procedure Guide*.

CHAPTER 5

Ethernet Cards

Note The terms "Unidirectional Path Switched Ring" and "UPSR" may appear in Cisco literature. These terms do not refer to using Cisco ONS 15xxx products in a unidirectional path switched ring configuration. Rather, these terms, as well as "Path Protected Mesh Network" and "PPMN," refer generally to Cisco's path protection feature, which may be used in any topological network configuration. Cisco does not recommend using its path protection feature in any particular topological network configuration.

The Cisco ONS 15454 SDH integrates Ethernet into a SDH time-division multiplexing (TDM) platform. This chapter describes the Cisco ONS 15454 SDH E-Series Ethernet cards, G1000-4 Ethernet cards, the G-1K-4 Ethernet card, ML-Series Ethernet cards, and the CE-Series cards. For Ethernet application information, see the *Ethernet Card Software Feature and Configuration Guide for the Cisco ONS 15454, Cisco ONS 15454 SDH, and Cisco ONS 15327.*

Chapter topics include:

- 5.1 Ethernet Card Overview, page 5-1
- 5.2 E100T-G Card, page 5-3
- 5.3 E1000-2-G Card, page 5-6
- 5.4 G1000-4 Card, page 5-9
- 5.5 G1K-4 Card, page 5-11
- 5.6 ML100T-12 Card, page 5-13
- 5.7 ML100X-8 Card, page 5-15
- 5.8 ML1000-2 Card, page 5-17
- 5.9 CE-100T-8 Card, page 5-19
- 5.10 CE-1000-4 Card, page 5-22
- 5.11 Ethernet Card GBICs and SFPs, page 5-25

5.1 Ethernet Card Overview

The card overview section summarizes the Ethernet card functions and provides the software compatibility for each Ethernet card.

Note Each card is marked with a symbol that corresponds to a slot (or slots) on the ONS 15454 SDH shelf assembly. The cards are then installed into slots displaying the same symbols. See the *Cisco ONS 15454 SDH Procedures Guide* for a list of slots and symbols.

5.1.1 Cards Summary

Table 5-1 lists the Cisco ONS 15454 SDH Ethernet cards.

Table 5-1 Ethernet Cards for the ONS 15454 SDH

Card	Port Description	For Additional Information...
E100T-G	The E100T-G card provides 12 switched, autosensing, 10/100BaseT Ethernet ports and is compatible with the XC-VXL-2.5G, XC-VXL-10G, and XC-VXC-10G cards.	See the "5.2 E100T-G Card" section on page 5-3.
E1000-2-G	The E1000-2-G card provides two IEEE-compliant, 1000-Mbps ports and is compatible with the XC-VXL-2.5G, XC-VXL-10G, and XC-VXC-10G cards. Gigabit Interface Converters (GBICs) are separate.	See the "5.3 E1000-2-G Card" section on page 5-6.
G1000-4	The G1000-4 card provides four IEEE-compliant, 1000-Mbps ports. GBICs are separate. The G1000-4 requires the XC10G card.	See the "5.4 G1000-4 Card" section on page 5-9
G1K-4	The G1K-4 card provides four IEEE-compliant, 1000-Mbps ports and is compatible with the XC-VXL-2.5G, XC-VXL-10G, and XC-VXC-10G cards. GBICs are separate. The G1K-4 card is functionally identical to the G1000-4 card.	See the "5.5 G1K-4 Card" section on page 5-11.
ML100T-12	The ML100T-12 card provides 12 switched, autosensing, 10/100Base-T Ethernet ports and is compatible with the XC-VXL-2.5G, XC-VXL-10G, and XC-VXC-10G cards.	See the "5.6 ML100T-12 Card" section on page 5-13.
ML100X-8	The ML100X-8 card provides eight switched, 100BaseFX Ethernet ports and is compatible with the XC-VXL-2.5G, XC-VXL-10G, and XC-VXC-10G cards.	See the "5.7 ML100X-8 Card" section on page 5-15.
ML1000-2	The ML1000-2 card provides two IEEE-compliant, 1000-Mbps ports and is compatible with the XC-VXL-2.5G, XC-VXL-10G, and XC-VXC-10G cards. Small form-factor pluggable (SFP) connectors are separate.	See the "5.8 ML1000-2 Card" section on page 5-17.

Table 5-1 Ethernet Cards for the ONS 15454 SDH (continued)

Card	Port Description	For Additional Information...
CE-100T-8	The CE-100T-8 card provides eight IEEE-compliant, 10/100-Mbps ports and is compatible with the XC-VXL-2.5G, XC-VXL-10G, and XC-VXC-10G cards.	See the "5.9 CE-100T-8 Card" section on page 5-19.
CE-1000-4	The CE-1000-4 card provides four IEEE-compliant, 1000-Mbps ports. The CE-1000-4 card can operate with the XC10G, XC-VXC-10G, XC-VXL-10G, or XC-VXL-2.5G cross-connect cards.	See the "5.10 CE-1000-4 Card" section on page 5-22.

5.1.2 Card Compatibility

Table 5-2 lists the CTC software compatibility for each Ethernet card.

Note "Yes" indicates that this card is fully or partially supported by the indicated software release. Refer to the individual card reference section for more information about software limitations for this card.

Table 5-2 Ethernet Card Software Compatibility

Ethernet Cards	R3.0.1	R3.1	R3.2	R3.3	R3.4	R4.0	R4.1	R4.5[1]	R4.6	R4.7[1]	R5.0	R6.0	R7.0
E100T-G	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	Yes	—	Yes	Yes	Yes
E1000-2-G	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	Yes	—	Yes	Yes	Yes
G1000-4	—	—	Yes	Yes	Yes	Yes	Yes	—	Yes	—	Yes	Yes	Yes
G1K-4	—	—	Yes	Yes	Yes	Yes	Yes	—	Yes	—	Yes	Yes	Yes
ML100T-12	—	—	—	—	—	Yes	Yes	—	Yes	—	Yes	Yes	Yes
ML100X-8	—	—	—	—	—	—	—	—	—	—	—	Yes	Yes
ML1000-2	—	—	—	—	—	Yes	Yes	—	Yes	—	Yes	Yes	Yes
CE-100T-8	—	—	—	—	—	—	—	—	—	—	—	Yes	Yes
CE-1000-4	—	—	—	—	—	—	—	—	—	—	—	—	Yes

1. DWDM-only release.

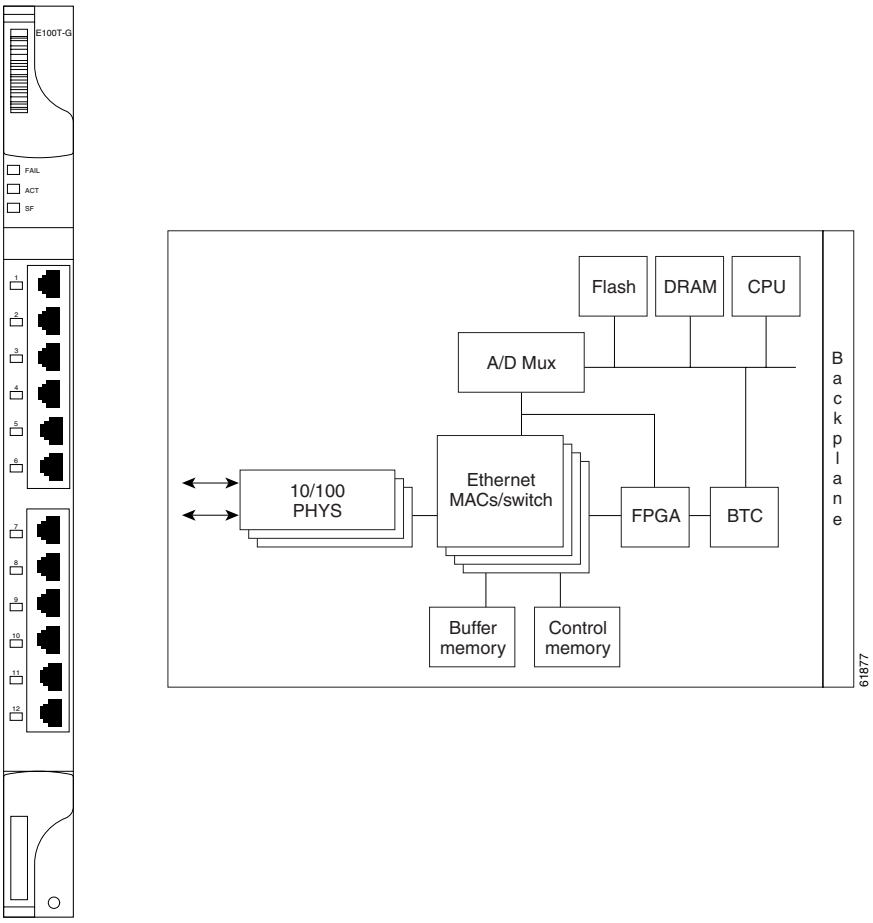
5.2 E100T-G Card

Note For specifcations, see the "A.7.1 E100T-G Card Specifications" section on page A-44.

The ONS 15454 SDH uses E100T-G cards for Ethernet (10 Mbps) and Fast Ethernet (100 Mbps). Each card provides 12 switched, IEEE 802.3-compliant, 10/100BaseT Ethernet ports that can independently detect the speed of an attached device (autosense) and automatically connect at the appropriate speed.

The ports autoconfigure to operate at either half or full duplex and determine whether to enable or disable flow control. You can also configure Ethernet ports manually. Figure 5-1 shows the faceplate and a block diagram of the card.

Figure 5-1 E100T-G Faceplate and Block Diagram



The E100T-G Ethernet card provides high-throughput, low-latency packet switching of Ethernet traffic across a SDH network while providing a greater degree of reliability through SDH self-healing protection services. This Ethernet capability enables network operators to provide multiple 10/100-Mbps access drops for high-capacity customer LAN interconnects, Internet traffic, and cable modem traffic aggregation. It enables the efficient transport and co-existence of traditional TDM traffic with packet-switched data traffic.

Each E100T-G card supports standards-based, wire-speed, Layer 2 Ethernet switching between its Ethernet interfaces. The IEEE 802.1Q tag logically isolates traffic (typically subscribers). IEEE 802.1Q also supports multiple classes of service.

5.2.1 E100T-G Slot Compatibility

You can install the E100T-G card in Slots 1 to 6 and 12 to 17. Multiple E-Series Ethernet cards installed in an ONS 15454 SDH can act independently or as a single Ethernet switch. You can create logical SDH ports by provisioning a number of SDH channels to the packet switch entity within the ONS 15454 SDH. Logical ports can be created with a bandwidth granularity of VC-4.

5.2.2 E100T-G Card-Level Indicators

The E100T-G card faceplate has three card-level LED indicators (Table 5-3).

Table 5-3 E100T-G Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card processor is not ready or that a catastrophic software failure occurred on the E100T-G card. As part of the boot sequence, the FAIL LED is turned on until the software deems the card operational.
Green ACT LED	The green ACT LED provides the operational status of the E100T-G. If the ACT LED is green, it indicates that the E100T-G card is active and the software is operational.
SF LED	Not used.

5.2.3 E100T-G Port-Level Indicators

The E100T-G card also has 12 pairs of LEDs (one pair for each port) to indicate port conditions (Table 5-4). You can find the status of the E100T-G card port using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot.

Table 5-4 E100T-G Port-Level Indicators

LED State	Description
Amber	Port is active (transmitting and/or receiving data). By default, indicates the transmitter is active but can be software controlled to indicate link status, duplex status, or receiver active.
Solid Green	Link is established. By default, indicates the link for this port is up, but can be software controlled to indicate duplex status, operating speed, or collision.

5.2.4 E100T-G Compatibility

The E100T-G card is compatible with the XC-VXL-2.5G, XC-VXL-10G, and XC-VXC-10G cards.

5.3 E1000-2-G Card

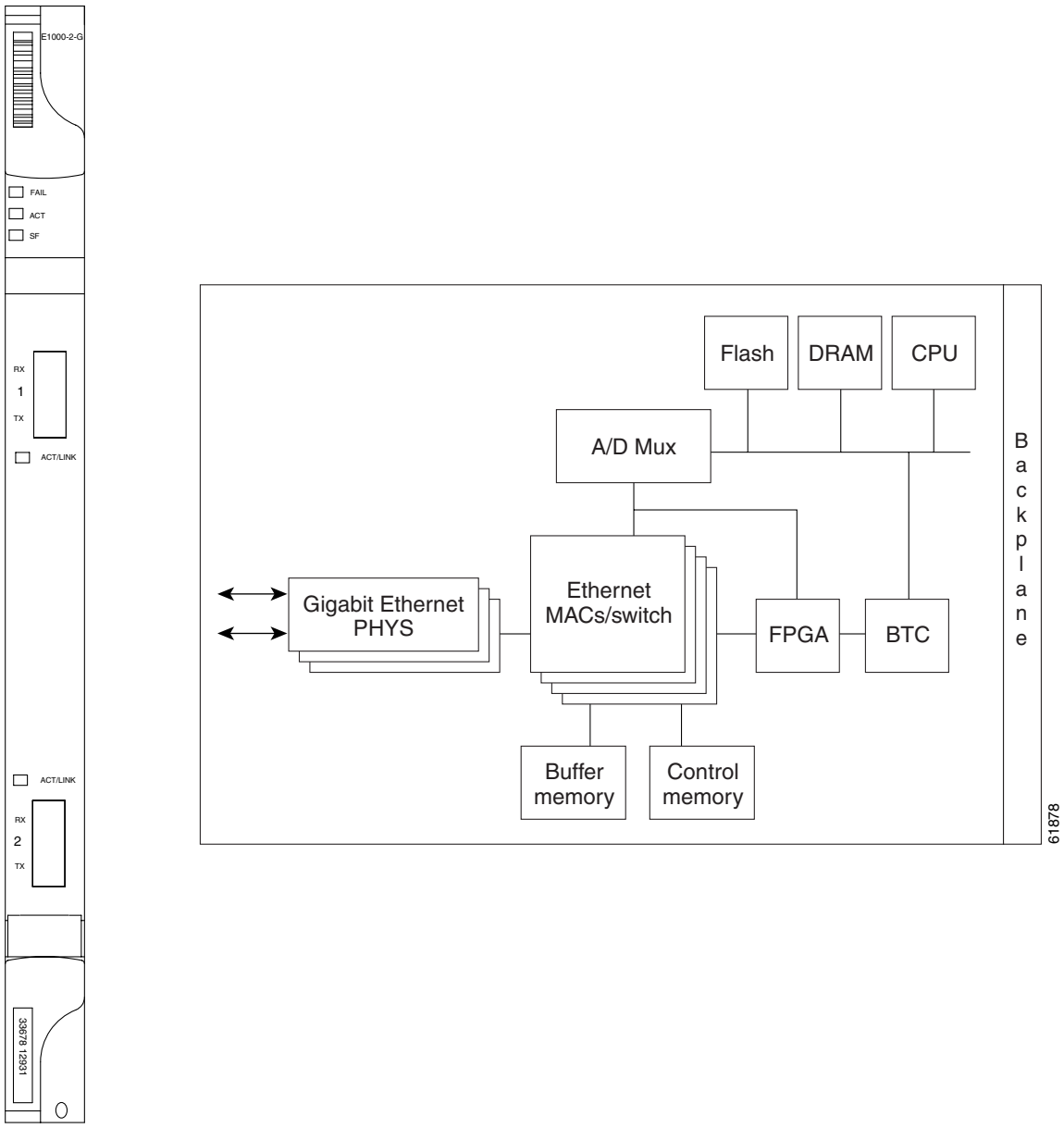
Note For specifications, see the "A.7.2 E1000-2-G Card Specifications" section on page A-45.

The ONS 15454 SDH uses E1000-2-G cards for Gigabit Ethernet (1000 Mbps). The E1000-2-G card provides two IEEE-compliant, 1000-Mbps ports for high-capacity customer LAN interconnections. Each port supports full-duplex operation.

The E1000-2-G card uses GBIC modular receptacles for the optical interfaces. For details, see the "5.11 Ethernet Card GBICs and SFPs" section on page 5-25.

Figure 5-2 shows the card faceplate and a block diagram of the card.

Figure 5-2 E1000-2-G Faceplate and Block Diagram



The E1000-2-G Gigabit Ethernet card provides high-throughput, low-latency packet switching of Ethernet traffic across a SDH network while providing a greater degree of reliability through SDH self-healing protection services. This enables network operators to provide multiple 1000-Mbps access drops for high-capacity customer LAN interconnects. It enables efficient transport and co-existence of traditional TDM traffic with packet-switched data traffic.

Each E1000-2-G card supports standards-based, Layer 2 Ethernet switching between its Ethernet interfaces and SDH interfaces on the ONS 15454 SDH. The IEEE 802.1Q VLAN tag logically isolates traffic (typically subscribers).

Multiple E-Series Ethernet cards installed in an ONS 15454 SDH can act together as a single switching entity or as independent single switches supporting a variety of SDH port configurations.

You can create logical SDH ports by provisioning a number of SDH channels to the packet switch entity within the ONS 15454 SDH. Logical ports can be created with a bandwidth granularity of VC-4.

5.3.1 E1000-2-G Card-Level Indicators

The E1000-2-G card faceplate has three card-level LED indicators (Table 5-5).

Table 5-5 E1000-2-G Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card processor is not ready or that a catastrophic software failure occurred on the E1000-2-G card. As part of the boot sequence, the FAIL LED is turned on until the software deems the card operational.
Green ACT LED	The green ACT LED provides the operational status of the E1000-2-G. If the ACT LED is green it indicates that the E1000-2-G card is active and the software is operational.
SF LED	Not used in this release.

5.3.2 E1000-2-G Port-Level Indicators

The E1000-2-G card also has one bicolor LED per port (Table 5-6). When the LINK LED is illuminated green, carrier is detected, meaning an active network cable is installed. When the LINK LED is not illuminated green, an active network cable is not plugged into the port, or the card is carrying unidirectional traffic. The port ACT LED flashes amber at a rate proportional to the level of traffic being received and transmitted over the port.

Table 5-6 E1000-2-G Port-Level Indicators

LED State	Description
Amber	The port is active (transmitting and receiving data).
Solid green	The link is established.
Green light off	The connection is inactive, or traffic is unidirectional.

5.3.3 E1000-2-G Compatibility

The E1000-2-G is compatible with any traffic card slots (Slots 1 to 6 and 12 to 17) and with the XC-VXL-2.5G, XC-VXL-10G, and XC-VXC-10G cards.

5.4 G1000-4 Card

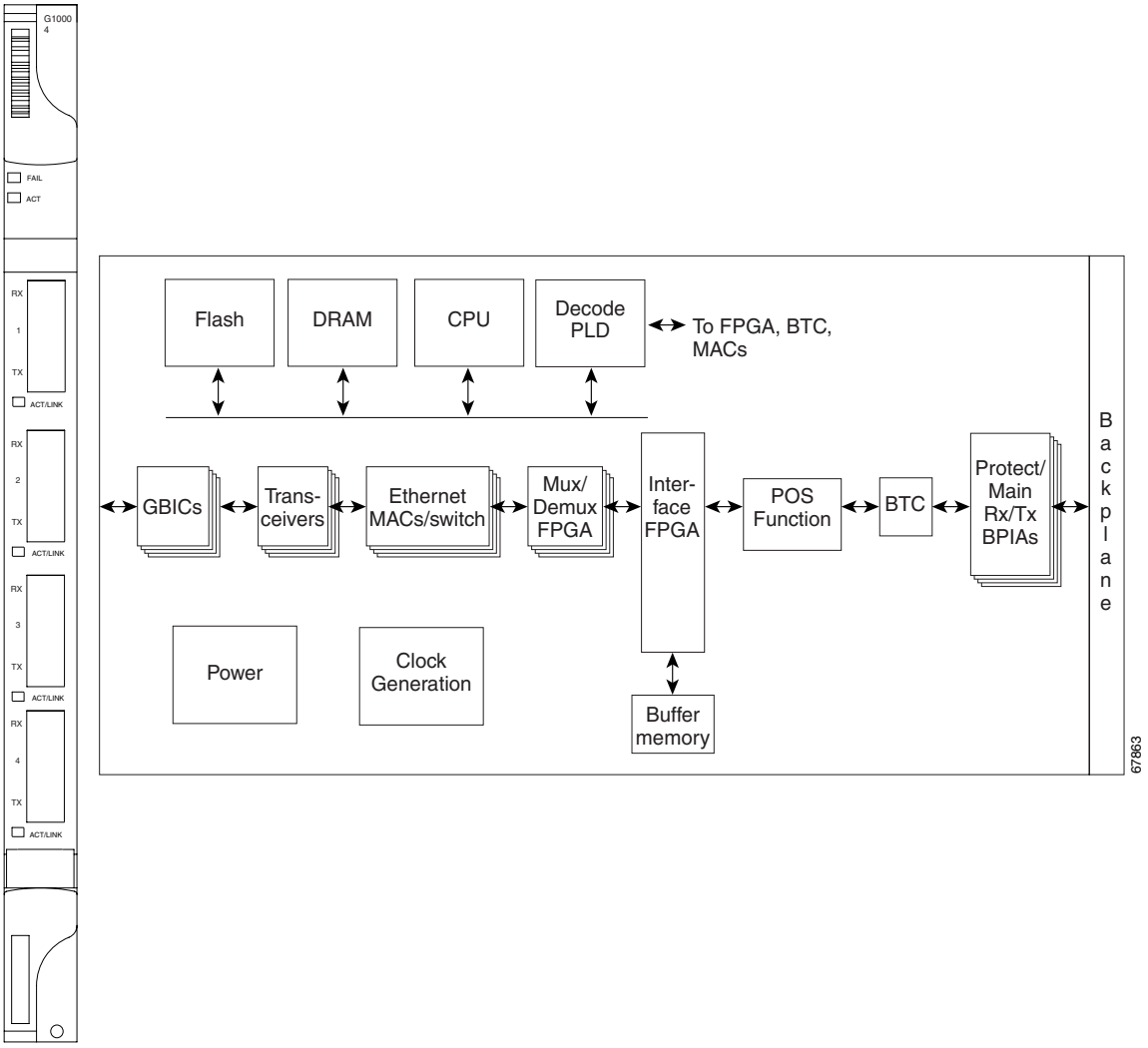
The G1000-4 card requires the XC10G card. The ONS 15454 uses G1000-4 cards for Gigabit Ethernet (1000 Mbps). The G1000-4 card provides four ports of IEEE-compliant, 1000-Mbps interfaces. Each port supports full-duplex operation for a maximum bandwidth of OC-48 on each card.

The G1000-4 card uses GBIC modular receptacles for the optical interfaces. For details, see the "5.11 Ethernet Card GBICs and SFPs" section on page 5-25.

Note Any new features that are available as part of this software release are not enabled for this card.

Figure 5-3 shows the card faceplate and the block diagram of the card.

Figure 5-3 G1000-4 Faceplate and Block Diagram



The G1000-4 Gigabit Ethernet card provides high-throughput, low latency transport of Ethernet encapsulated traffic (IP and other Layer 2 or Layer 3 protocols) across a SONET network. Carrier-class Ethernet transport is achieved by hitless (< 50 ms) performance in the event of any failures or protection

switches (such as 1+1 automatic protection switching [APS], path protection, or bidirectional line switch ring [BLSR]). Full provisioning support is possible through Cisco Transport Controller (CTC), Transaction Language One (TL1), or Cisco Transport Manager (CTM).

The circuit sizes supported are STS-1, STS-3c, STS-6c, STS-9c, STS-12c, STS-24c, and STS-48c.

5.4.1 STS-24c Restriction

Due to hardware constraints, the card imposes an additional restriction on the combinations of circuits that can be dropped onto a G-Series card. These restrictions are transparently enforced by the ONS 15454, and you do not need to keep track of restricted circuit combinations.

When a single STS-24c terminates on a card, the remaining circuits on that card can be another single STS-24c or any combination of circuits of STS-12c size or less that add up to no more than 12 STSs (that is a total of 36 STSs on the card).

If STS-24c circuits are not being dropped on the card, the full 48 STSs bandwidth can be used with no restrictions (for example, using either a single STS-48c or 4 STS-12c circuits).

Note The STS-24c restriction only applies when a single STS-24c circuit is dropped; therefore, you can easily minimize the impact of this restriction. Group the STS-24c circuits together on a card separate from circuits of other sizes. The grouped circuits can be dropped on other G-Series cards on the ONS 15454.

5.4.2 G1000-4 Card-Level Indicators

The G1000-4 card faceplate has two card-level LED indicators, described in Table 5-7.

Table 5-7 G1000-4 Card-Level Indicators

Card-Level LEDs	Description
FAIL LED (red)	The red FAIL LED indicates that the card's processor is not ready or that a catastrophic software failure occurred on the G1000-4 card. As part of the boot sequence, the FAIL LED is turned on, and it turns off if the software is deemed operational. The red FAIL LED blinks when the card is loading software.
ACT LED (green)	A green ACT LED provides the operational status of the G1000-4. If the ACT LED is green, it indicates that the G1000-4 card is active and the software is operational.

5.4.3 G1000-4 Port-Level Indicators

The G1000-4 card has one bicolor LED per port. Table 5-8 describes the status that each color represents.

Table 5-8 G1000-4 Port-Level Indicators

Port-Level LED Status	Description
Off	No link exists to the Ethernet port.
Steady amber	A link exists to the Ethernet port, but traffic flow is inhibited. For example, an unconfigured circuit, an error on line, or a nonenabled port might inhibit traffic flow.
Solid green	A link exists to the Ethernet port, but no traffic is carried on the port.
Flashing green	A link exists to the Ethernet port, and traffic is carried on the port. The LED flash rate reflects the traffic rate for the port.

5.4.4 Slot Compatibility

The G1000-4 card requires Cisco ONS 15454 Release 3.2 or later system software and the XC10G cross-connect card. You can install the card in Slots 1 to 6 and 12 to 17, for a total shelf capacity of 48 Gigabit Ethernet ports. The practical G1000-4 port per shelf limit is 40, because at least two slots are typically filled by OC-N trunk cards such as the OC-192.

5.5 G1K-4 Card

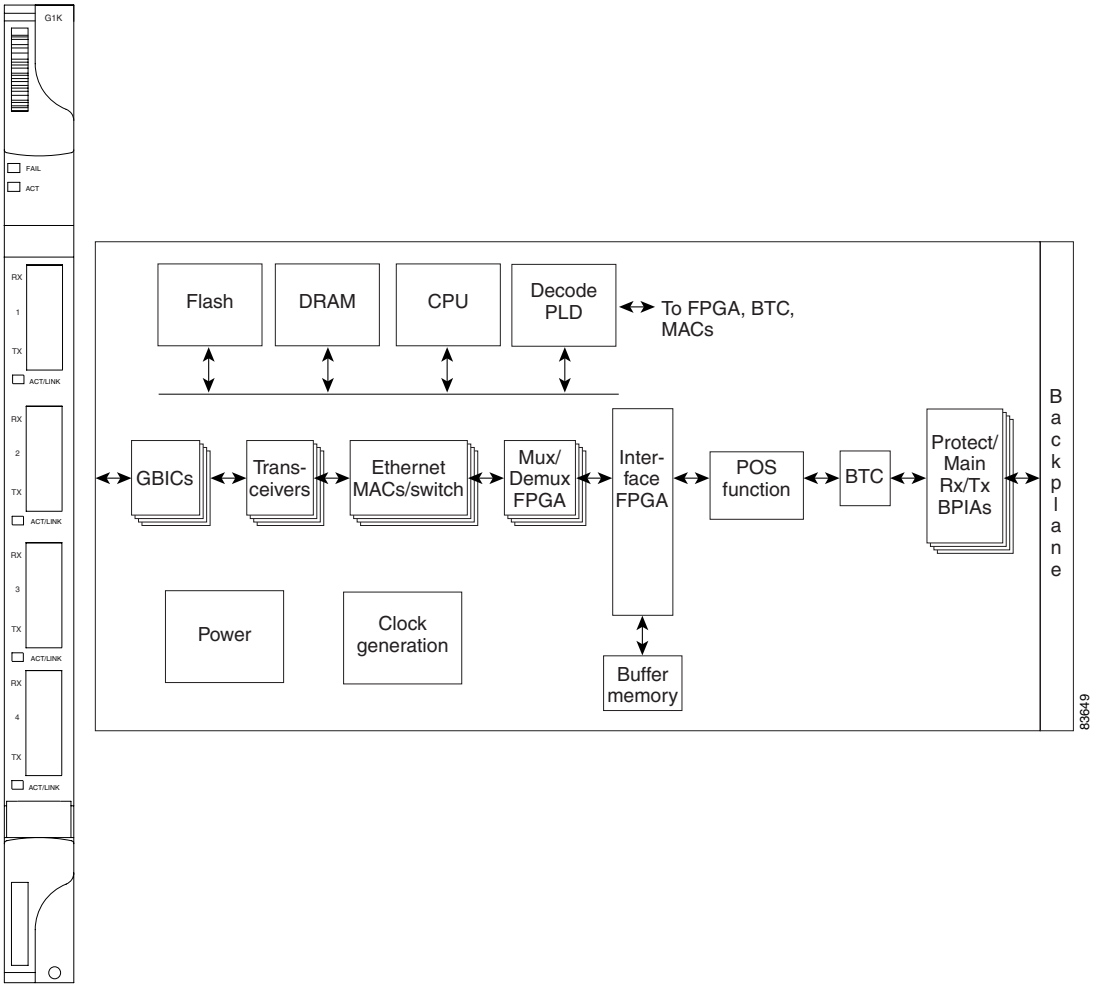
Note For specifications, see the "A.7.5 G1K-4 Card Specifications" section on page A-46.

Note Any new features that are available as part of this software release are not enabled for this card.

The G1K-4 card is the functional equivalent of the earlier G1000-4 card and provides four ports of IEEE-compliant, 1000-Mbps interfaces. Each interface supports full-duplex operation for a maximum bandwidth of 1 Gbps or 2 Gbps bidirectional per port, and 2.5 Gbps or 5 Gbps bidirectional per card. Each port autonegotiates for full duplex and IEEE 802.3x flow control. The G1K-4 card uses GBIC modular receptacles for the optical interfaces. For details, see the "5.11 Ethernet Card GBICs and SFPs" section on page 5-25.

Figure 5-4 shows the card faceplate and the block diagram of the card.

Figure 5-4 G1K-4 Faceplate and Block Diagram



The G1K-4 Gigabit Ethernet card provides high-throughput, low-latency transport of Ethernet encapsulated traffic (IP and other Layer 3 protocols) across a SDH network while providing a greater degree of reliability through SDH self-healing protection services. Carrier-class Ethernet transport is achieved by hitless (< 50 ms) performance in the event of any failures or protection switches (such as 1+1 APS, path protection, BLSR, or optical equipment protection) and full provisioning and manageability, as in SDH service. Full provisioning support is possible via CTC or CTM. Each G1K-4 card performs independently of the other cards in the same shelf.

5.5.1 G1K-4 Card-Level Indicators

The G1K-4 card faceplate has two card-level LED indicators, described in Table 5-9.

Table 5-9 G1K-4 Card-Level Indicators

Card-Level LEDs	Description
FAIL LED (red)	The red FAIL LED indicates that the card processor is not ready or that a catastrophic software failure occurred on the G1K-4 card. As part of the boot sequence, the FAIL LED is turned on, and it goes off when the software is deemed operational. The red FAIL LED blinks when the card is loading software.
ACT LED (green)	The green ACT LED provides the operational status of the G1K-4. If the ACT LED is green, it indicates that the G1K-4 card is active and the software is operational.

5.5.2 G1K-4 Port-Level Indicators

The G1K-4 card has four bicolor LEDs (one LED per port). Table 5-10 describes these LEDs.

Table 5-10 G1K-4 Port-Level Indicators

Port-Level LED State	Description
Off	No link exists to the Ethernet port.
Steady amber	A link exists to the Ethernet port, but traffic flow is inhibited. For example, a lack of circuit setup, an error on the line, or a nonenabled port might inhibit traffic flow.
Solid green	A link exists to the Ethernet port, but no traffic is carried on the port.
Flashing green	A link exists to the Ethernet port, and traffic is carried on the port. The LED flash rate reflects the traffic rate for the port.

5.5.3 G1K-4 Compatibility

You can install the G1K-4 card in Slots 1 to 6 and 12 to 17, for a total shelf capacity of 48 Gigabit Ethernet ports. (The practical limit is 40 ports because at least two slots are typically populated by optical cards such as the OC-192.)

The G1K-4 card operate with the XC-VXL-2.5G, XC-VXL-10G, or XC-VXC-10G cross-connect cards.

5.6 ML100T-12 Card

Note For specifications, see the "A.7.6 ML100T-12 Card Specifications" section on page A-46.

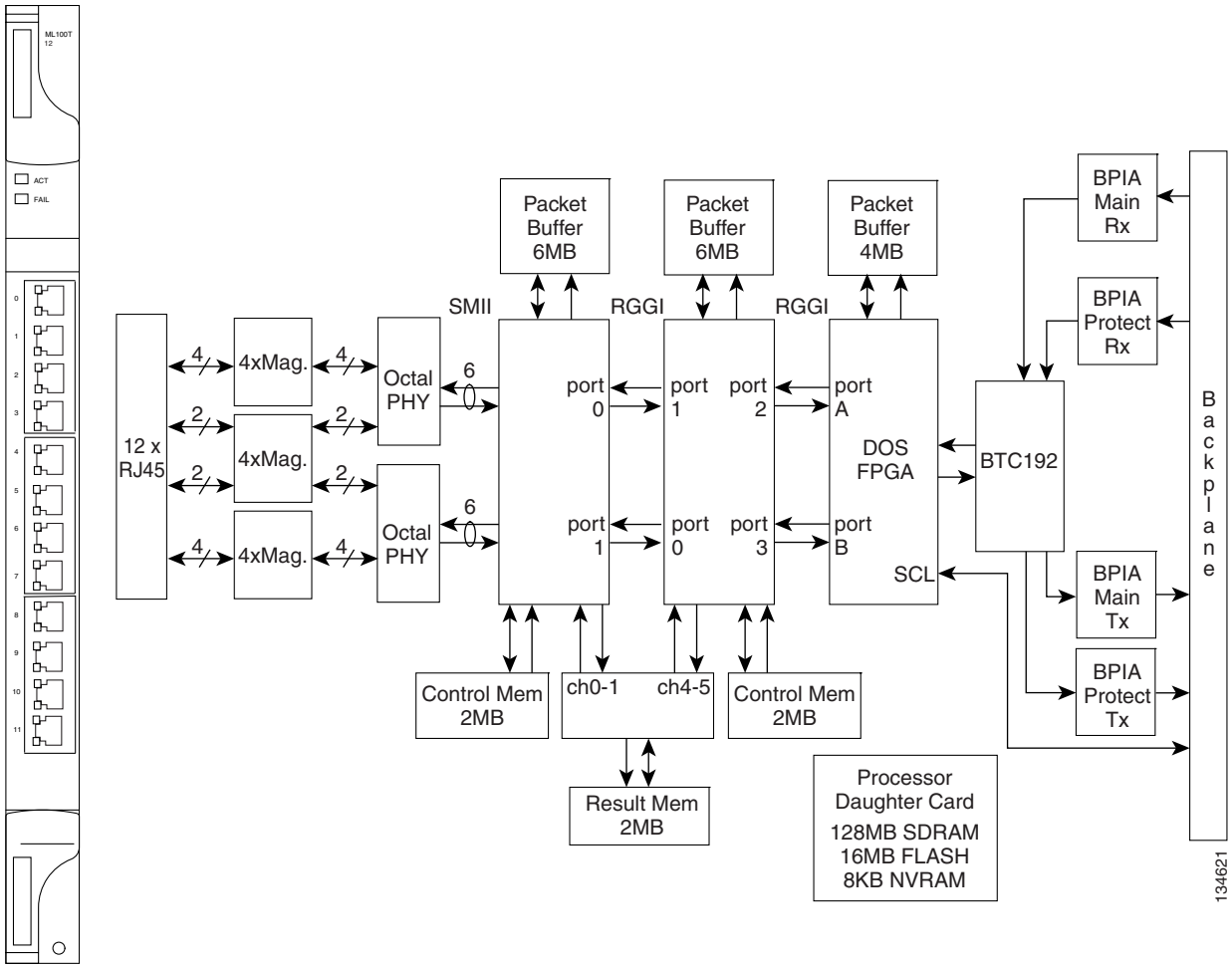
The ML100T-12 card provides 12 ports of IEEE 802.3-compliant, 10/100 interfaces. Each interface supports full-duplex operation for a maximum bandwidth of 200 Mbps per port and 2.488 Gbps per card. Each port independently detects the speed of an attached device (autosenses) and automatically connects at the appropriate speed. The ports autoconfigure to operate at either half or full duplex and can

determine whether to enable or disable flow control. For ML-Series configuration information, see the *Ethernet Card Software Feature and Configuration Guide for the Cisco ONS 15454, Cisco ONS 15454 SDH, and Cisco ONS 15327.*

Figure 5-5 shows the card faceplate and block diagram.

Caution Shielded twisted-pair cabling should be used for inter-building applications.

Figure 5-5 ML100T-12 Faceplate and Block Diagram



ML-Series cards feature two SDH virtual ports with a maximum combined bandwidth of VC4-16c. Each port carries an STM concatenated circuit (CCAT) with a size of VC3, VC4, VC4-2c, VC4-3c, VC4-4c, and VC4-8c. To configure an ML-Series card SDH STM circuit, refer to the "Create Circuits and Low-Order Tunnels" chapter of the *Cisco ONS 15454 SDH Procedure Guide.*

The ML-Series packet-over-SDH (POS) ports supports virtual concatenation (VCAT) of SONET/SDH circuits and a software link capacity adjustment scheme (SW-LCAS). The ML-Series card supports a maximum of two VCAT groups with each group corresponding to one of the POS ports. Each VCAT group must be provisioned with two circuit members. An ML-Series card supports VC-3-2v, VC-4-2v and VC-4-4c-2v. To configure an ML-Series card SDH VCAT circuit, refer to the "Create Circuits and Low-Order Tunnels" chapter of the *Cisco ONS 15454 SDH Procedure Guide.*

5.6.1 ML100T-12 Card-Level Indicators

The ML00T-12 card supports two card-level LED indicators, described in Table 5-11.

Table 5-11 ML100T-12 Card-Level Indicators

Card-Level LEDs	Description
Red SF LED	The red SF LED indicates that the card processor is not ready or that a catastrophic software failure occurred on the ML100T-12 card. As part of the boot sequence, the FAIL LED is illuminated until the software deems the card operational.
Green ACT LED	The green ACT LED provides the operational status of the ML100T-12. If the ACT LED is green, it indicates that the ML100T-12 card is active and the software is operational.

5.6.2 ML100T-12 Port-Level Indicators

The ML100T-12 card provides a pair of LEDs for each Fast Ethernet port: an amber LED for activity (ACT) and a green LED for LINK. The port-level indicators are described in Table 5-12.

Table 5-12 ML100T-12 Port-Level Indicators

Port-Level LED State	Description
ACT LED (Amber)	Steady amber LED indicates that a link is detected, but there is an issue inhibiting traffic. A blinking amber LED means that traffic is flowing.
LINK LED (Green)	Steady green LED indicates that a link is detected, but there is no traffic. A blinking green LED flashes at a rate proportional to the level of traffic being received and transmitted over the port.
Both ACT and LINK LED	Unlit green and amber LEDs indicate no traffic.

5.6.3 ML100T-12 Compatibility

The ML100T-12 card is compatible in Slots 1 to 6 or 12 to 17. The ML100T-12 card operates with the XC-VXL-2.5G, XC-VXL-10G, or XC-VXC-10G cards.

5.7 ML100X-8 Card

Note For specifications, see the "A.7.8 ML100X-8 Card Specifications" section on page A-47.

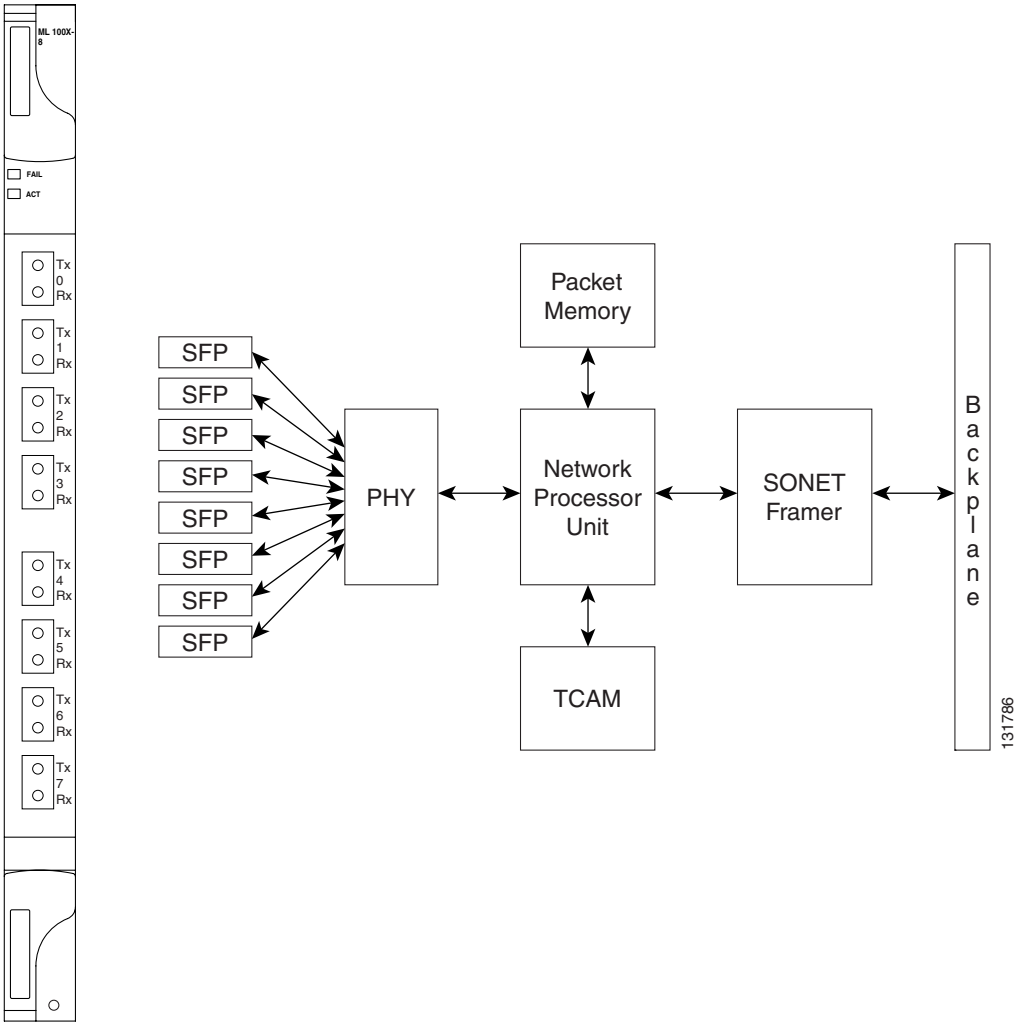
The ML100X-8 card provides eight ports with 100 base FX interfaces. The ports are numbered 0 through 7. The ML100X-8 interfaces support one of two connectors, an LX SFP or an FX SFP. The100 Mbps 802.3-compliant LX SFP operates over a pair of single-mode optical fibers and includes LC connectors.

The 100 Mbps 802.3-compliant FX SFP operates over a pair of multimode optical fibers and includes LC connectors. For more information on SFPs, see the "5.11 Ethernet Card GBICs and SFPs" section on page 5-25.

Each interface supports full-duplex operation for a maximum bandwidth of 200 Mbps per port and 2.488 Gbps per card. For ML-Series configuration information, see the *Ethernet Card Software Feature and Configuration Guide for the Cisco ONS 15454, Cisco ONS 15454 SDH, and Cisco ONS 15327*.

Figure 5-6 shows the card faceplate and block diagram.

Figure 5-6 ML100X-8 Faceplate and Block Diagram



ML-Series cards feature two SDH virtual ports with a maximum combined bandwidth of VC4-16c. Each port carries an STM concatenated circuit (CCAT) with a size of VC3, VC4, VC4-2c, VC4-3c, VC4-4c, and VC4-8c. To configure an ML-Series card STM circuit, refer to the "Create Circuits and Low-Order Tunnels" chapter of the *Cisco ONS 15454 SDH Procedure Guide.*

The ML-Series packet-over-SDH (POS) ports supports virtual concatenation (VCAT) of SDH circuits and a software link capacity adjustment scheme (SW-LCAS). The ML-Series card supports a maximum of two VCAT groups with each group corresponding to one of the POS ports. Each VCAT group must

be provisioned with two circuit members. An ML-Series card supports VC-3-2v, VC-4-2v and VC-4-4c-2v. To configure an ML-Series-card VCAT circuit, refer to the "Create Circuits and Low-Order Tunnels" chapter of the *Cisco ONS 15454 SDH Procedure Guide*.

5.7.1 ML100X-8 Card-Level Indicators

The ML100X-8 card supports two card-level LED indicators. The card-level indicators are described in Table 5-13.

Table 5-13 ML100X-8 Card-Level Indicators

Card-Level LEDs	Description
Red FAIL LED	The red FAIL LED indicates that the card processor is not ready or that a catastrophic software failure occurred on the ML100X-8 card. As part of the boot sequence, the FAIL LED is turned on until the software deems the card operational.
Green ACT LED	The green ACT LED provides the operational status of the ML100X-8. If the ACT LED is green, it indicates that the ML100X-8 card is active and the software is operational.

5.7.2 ML100X-8 Port-Level Indicators

The ML100X-8 card provides a pair of LEDs for each Fast Ethernet port: an amber LED for activity (ACT) and a green LED for LINK. The port-level indicators are described in Table 5-14.

Table 5-14 ML100X-8 Port-Level Indicators

Port-Level Indicators	Description
ACT LED (Amber)	A blinking amber LED means there is traffic flowing. An unlit LED indicates no traffic.
LINK LED (Green)	A steady green LED indicates a link is detected. An unlit LED indicates the link is down
Both ACT and LINK LED	Unlit green and amber LEDs indicate no traffic.

5.7.3 ML100X-8 Compatibility

The ML100X-8 card is compatible in Slots 1 to 6 or 12 to 17. The ML100X-8 card operates with the XC-VXL-2.5G, XC-VXL-10G, or XC-VXC-10G cross-connect cards.

5.8 ML1000-2 Card

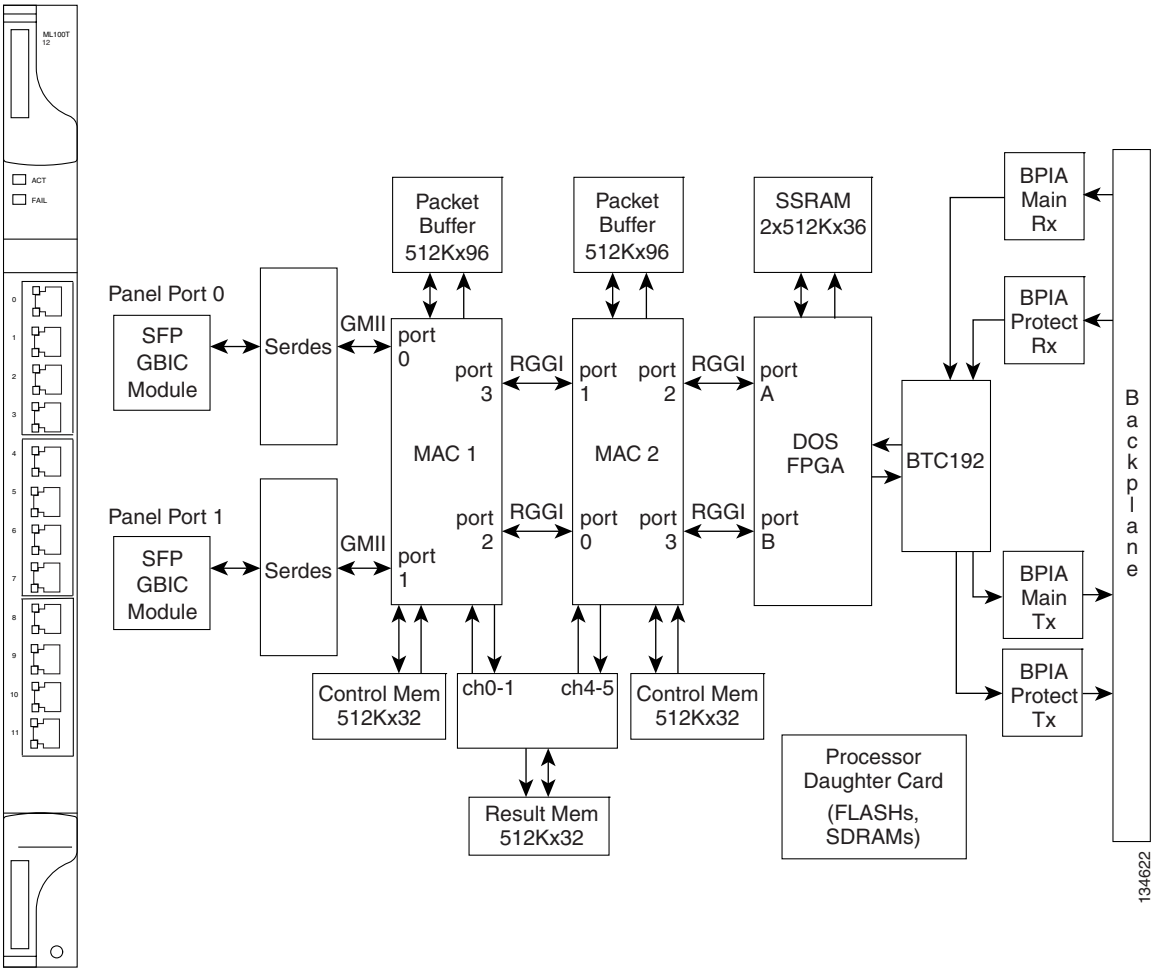
Note For ML1000-2 specifications, see the "A.7.7 ML1000-2 Card Specifications" section on page A-47.

The ML1000-2 card provides two ports of IEEE-compliant, 1000-Mbps interfaces. Each interface supports full-duplex operation for a maximum bandwidth of 2 Gbps per port and 4 Gbps per card. Each port autoconfigures for full duplex and IEEE 802.3x flow control.

SFP modules are offered as separate orderable products for maximum customer flexibility. For details, see the "5.11 Ethernet Card GBICs and SFPs" section on page 5-25.

Figure 5-7 shows the ML1000-2 card faceplate and block diagram.

Figure 5-7 ML1000-2 Faceplate and Block Diagram



ML-Series cards feature two SDH virtual ports with a maximum combined bandwidth of VC4-16c. Each port carries an STM circuit with a size of VC3, VC4, VC4-2c, VC4-3c, VC4-4c, and VC4-8c. To configure an ML-Series card SDH STM circuit, refer to the "Create Circuits and Low-Order Tunnels" chapter of the *Cisco ONS 15454 SDH Procedure Guide*.

The ML-Series POS ports supports VCAT of SONET/SDH circuits and a software link capacity adjustment scheme (SW-LCAS). The ML-Series card supports a maximum of two VCAT groups with each group corresponding to one of the POS ports. Each VCAT group must be provisioned with two circuit members. An ML-Series card supports VC-3-2v, VC-4-2v and VC-4-4c-2v. To configure an ML-Series card SDH VCAT circuit, refer to the "Create Circuits and Low-Order Tunnels" chapter of the *Cisco ONS 15454 SDH Procedure Guide*.

5.8.1 ML1000-2 Card-Level Indicators

The ML1000-2 card faceplate has two card-level LED indicators, described in Table 5-15.

Table 5-15 ML1000-2 Card-Level Indicators

Card-Level LEDs	Description
FAIL LED (Red)	The red FAIL LED indicates that the card processor is not ready or that a catastrophic software failure occurred on the ML1000-2 card. As part of the boot sequence, the FAIL LED is turned on until the software deems the card operational.
ACT LED (Green)	The green ACT LED provides the operational status of the ML1000-2. When the ACT LED is green, it indicates that the ML1000-2 card is active and the software is operational.

5.8.2 ML1000-2 Port-Level Indicators

The ML1000-2 card has two LEDs for each of the two Gigabit Ethernet ports. The port-level indicators are described in Table 5-16.

Table 5-16 ML1000-2 Port-Level Indicators

Port-Level LED State	Description
ACT LED (Amber)	Steady amber LED indicates that a link is detected, but there is an issue inhibiting traffic. Blinking amber LED means that traffic is flowing.
LINK LED (Green)	Steady green LED indicates that a link is detected, but there is no traffic. A blinking green LED flashes at a rate proportional to the level of traffic being received and transmitted over the port.
Both ACT and LINK LED	Unlit green and amber LEDs indicate no traffic.

5.8.3 ML1000-2 Slot Compatibility

The ML1000-2 card operates in Slots 1 to 6 or 12 to 17 and operates with the XC-VXL-2.5G, XC-VXL-10G, or XC-VXC-10G cards.

5.9 CE-100T-8 Card

Note For specifications, see the "A.7.4 CE-100T-8 Card Specifications" section on page A-45.

The CE-100T-8 card provides eight RJ-45 10/100 Mbps Ethernet ports accessible on the faceplate. The ports are numbered 1 through 8. The 10/100 Mbps Ethernet traffic on these ports map into SDH payloads for transport over the SDH infrastructure.

The SDH circuit sizes and types supported are:

- CCAT sizes of VC-3 and VC-4

- Low order (LO) VCAT VC-3 circuit sizes of up to three members: VC-3-1v, VC-3-2v, or VC-3-3v
- Low order (LO) VCAT VC-12 circuit sizes of up to 63 members: VC-12-Nv (where N=1 to 63)

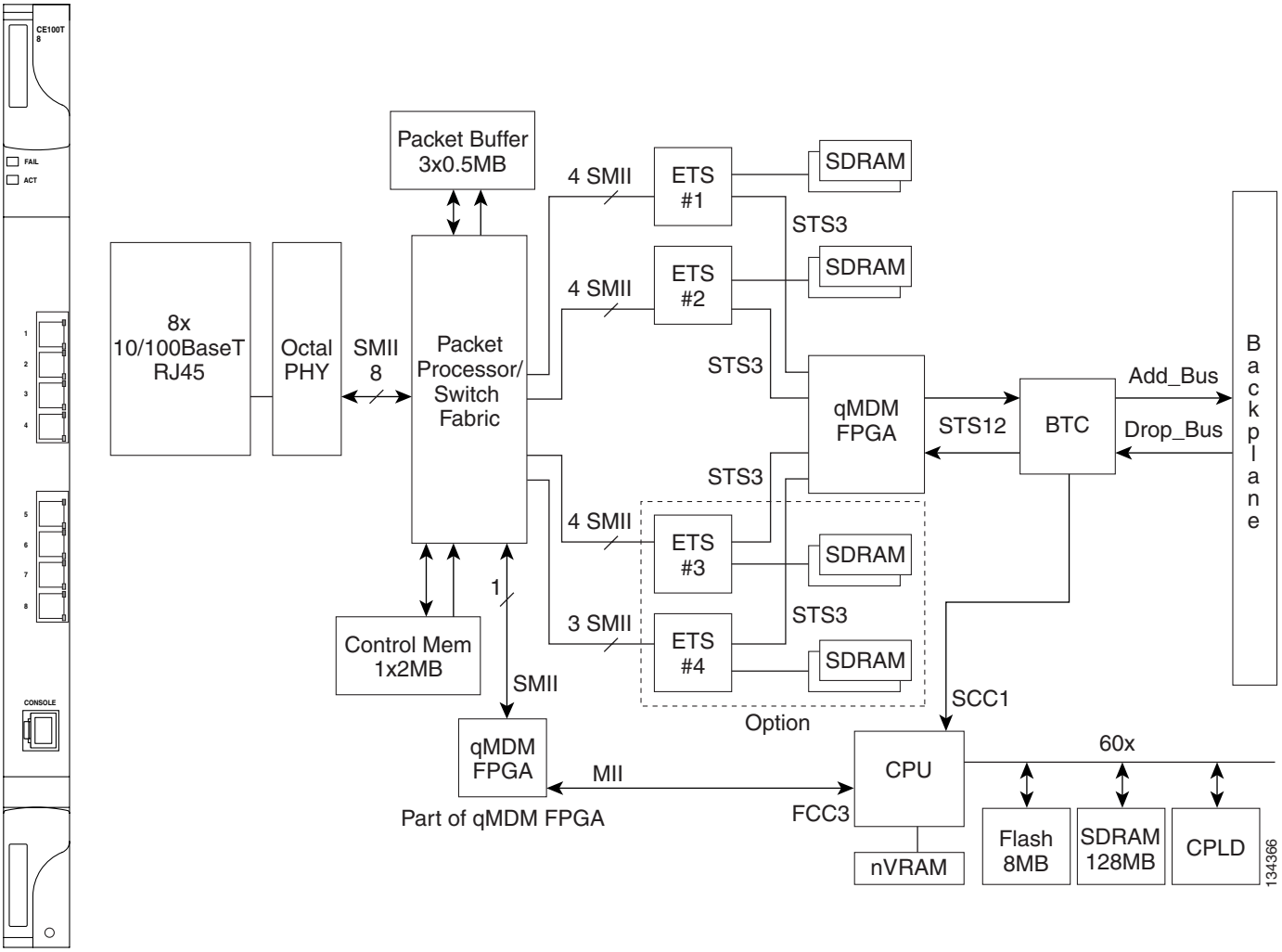
VC-3 VCAT circuits map administrative unit 4 (AU-4), and VC-12 VCAT circuits map tributary unit 12 (TU-12).

In addition, the CE-100T-8 card supports Generic Framing Procedure (GFP-F) and point-to-point protocol/high-level data link control (PPP/HDLC) framing protocols. It also supports the link capacity adjustment scheme (LCAS), which allows dynamic reconfiguration of the VC groups.

The CE-100T8 card also supports the link capacity adjustment scheme (LCAS), which allows hitless dynamic adjustment of SONET link bandwidth. The CE-100T-8 card's LCAS is hardware-based, but the CE-100T-8 also supports SW-LCAS. This makes it compatible with the ONS 15454 SDH ML-Series card, which supports only SW-LCAS and does not support the standard hardware-based LCAS. SW-LCAS is supported when a circuit from the CE-100T-8 terminates on the ONS 15454 SDH ML-Series card.

Figure 5-8 shows the CE-100T-8 card faceplate and block diagram.

Figure 5-8 CE-100T-8 Faceplate and Block Diagram



The following paragraphs describe the general functions of the CE-100T-8 card and relate to the block diagram. In the ingress direction, (Ethernet-to-SDH), the PHY, which performs all of the physical layer interface functions for 10/100 Mbps Ethernet, sends the frame to the network processor for queuing in the respective packet buffer memory. The network processor performs packet processing, packet switching, and classification. The Ethernet frames are then passed to the Ethermap where Ethernet traffic is terminated and is encapsulated using HDLC or GFP-F framing on a per port basis.

The encapsulated Ethernet frames are then mapped into a configureable number of concatenated or virtual concatenated payloads.

The SDH SPEs carrying encapsulated Ethernet frames are passed onto the qMDM FPGA, where the STM-1 frames are multiplexed to form an STM-4 frame. The STM-4 frame is transported over the SDH network by means of the Bridging Convergence Transmission (BTC) ASIC.

In the Egress direction (SDH-to-Ethernet), the FPGA extracts four STM-1 frames from the STM-4 frame it receives from the BTC and sends each of the STM-1s to the ET3 mappers. The STM-1 SPE carrying GFP-F or PPP/HDLC encapsulated Ethernet frames is then extracted and buffered in Ethermap's external memory. This memory is used for providing alignment and differential delay compensation for the received virtual concatenated payloads. After alignment and delay compensation have been done, the Ethernet frames are decapsulated with one of the framing protocols (GFP-F or HDLC). Decapsulated Ethernet frames are then passed onto the network processor for QoS queuing and traffic scheduling. The network processor switches the frame to one of the corresponding PHY channels and then to the Ethernet port for external transmission.

For information on the CE-100T-8 QoS features, see the *Ethernet Card Software Feature and Configuration Guide for the Cisco ONS 15454, Cisco ONS 15454 SDH, and Cisco ONS 15327.*

5.9.1 CE-100T-8 Card-Level Indicators

The CE-100T-8 card faceplate has two card-level LED indicators, described in Table 5-17.

Table 5-17 CE-100T-8 Card-Level Indicators

Card-Level LEDs	Description
FAIL LED (Red)	A steady red indicates equipment failure on the CE-100T-8 card. A blinking red indicates the card is rebooting and going through memory check.
ACT LED (Green)	A steady green indicates an active card with operational software.

5.9.2 CE-100T-8 Port-Level Indicators

The CE-100T-8 card has two LEDs embedded into each of the eight Ethernet port RJ-45 connectors. The LEDs are described in Table 5-18.

Table 5-18 CE-100T-8 Port-Level Indicators

Port-Level Indicators	Description
LINK LED on Individual Port	A steady green indicates that a link is detected. An unlit LED means no link is detected.
ACT LED on Individual Port	Blinking amber means traffic is flowing. An unlit LED means no traffic flowing.

5.9.3 CE-100T-8 Compatibility

The CE-100T-8 card operates in Slots 1 to 6 or 12 to 17 and operates with the XC-VXL-2.5G, XC-VXL-10G, or XC-VXC-10G cards.

5.10 CE-1000-4 Card

Note For hardware specifications, see the "A.7.3 CE-1000-4 Card Specifications" section on page A-45.

The CE-1000-4 card uses pluggable Gigabit Interface Converters (GBICs) to transport Ethernet traffic over a SDH network. The CE-1000-4 provides four IEEE 802.3-compliant, 1000-Mbps Gigabit Ethernet ports at the ingress. At the egress, the CE-1000-4 card provides an integrated Ethernet over SDH mapper with four virtual ports to transfer Ethernet packets over a SDH network.

The Ethernet ports automatically configure to operate at either half or full duplex and can determine whether to enable or disable flow control. The Ethernet ports can also be oversubscribed using flow control.

The Ethernet frames are encapsulated using the ITU-T generic framing procedure (GFP) (with or without CRC) or LEX, the point-to-point protocol (PPP) with high-level data link control (HDLC). The CE-1000-4 card can interoperate with G1000-4/G1K-4 cards (using LEX encapsulation), CE-100T-8 cards (using LEX or GFP-F), and ML-Series cards (using LEX or GFP-F).

The Ethernet frames can be mapped into:

- Virtual concatenated (VCAT) payloads: VC-4-nv where n is 1 to 7.

  Note The CE-1000-4 card does not support VC-3 member sizes.

- Contiguously concatenated (CCAT) SDH payloads: VC-4, VC-4-2c, VC-4-3c, VC-4-4c, VC-4-6c, VC-4-8c, and VC-4-16c.

To configure a CE-1000-4 card SDH circuit, refer to the "Create Circuits and Low-Order Tunnels" chapter of the *Cisco ONS 15454 SDH Procedure Guide.*

The CE-1000-4 card provides multiple management options through Cisco Transport Controller (CTC), Cisco Transport Manager (CTM), Transaction Language 1 (TL1), and Simple Network Management Protocol (SNMP).

The CE-1000-4 card supports the software link capacity adjustment scheme (SW-LCAS). This makes it compatible with the ONS 15454 CE-100T-8 and ML-Series cards. The CE-1000-4 card supports VCAT groups (VCGs) that are reconfigurable when SW-LCAS is enabled (flexible VCGs). The CE-1000-4 card does not support the standard hardware-based LCAS.

The following guidelines apply to flexible VCGs:

- Members can be added or removed from VCGs.
- Members can be put into or out of service.
- Cross-connects can be added or removed from VCGs.
- Errored members will be automatically removed from VCGs.
- Adding or removing members from the VCG is service affecting.

- Adding or removing cross connects from the VCG is not service affecting if the associated members are not in group.

The CE-1000-4 card supports a non link capacity adjustment scheme (no-LCAS). This also makes it compatible with the ONS 15454 CE-100T-8 and ML-Series cards. The CE-1000-4 card supports VCAT groups (VCGs) that are fixed and not reconfigurable when no-LCAS is enabled (fixed VCGs).

The following guidelines apply to fixed VCGs:

- Members can be added or removed from VCGs using CTC or TL1.
- Members cannot be put into or out of service unless the force command mode is instantiated.

Note This is possible with CTC as it assumes the force command mode by default. However, to put members into or out of service using TL1, the force command mode must be set.

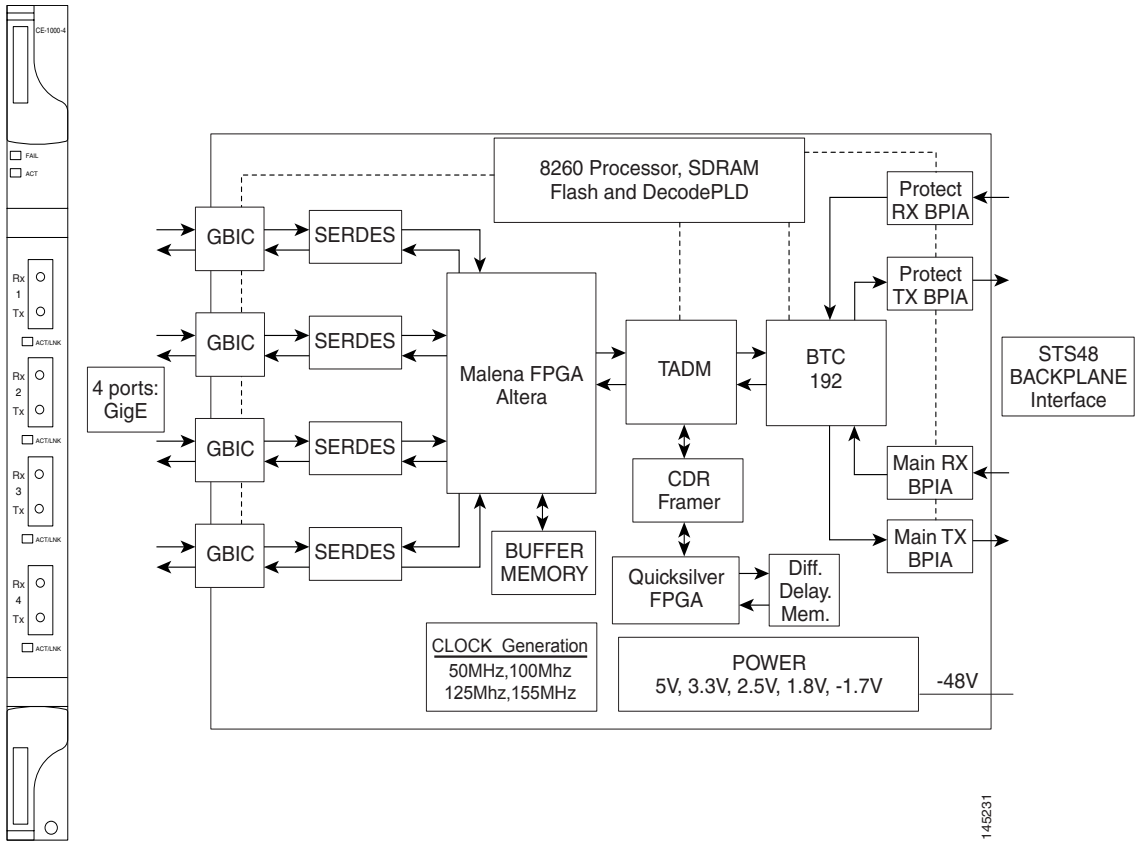
- Cross-connects can be added or removed from VCGs using CTC or TL1. This is service affecting as long as the VCG size (TXCOUNT) is not realigned with the loss of connections.

The CE-1000-4 card supports VCAT differential delay and provides these associated features:

- Supports a maximum VCG differential delay of 122 ms in each direction.
- Supports all protection schemes (path protection, two-fiber BLSR, four-fiber BLSR) on VCAT circuits that are split-fiber routed.
- Supports two-fiber BLSR on VCAT circuits that are common-fiber routed.
- Differential delay compensation is automatically enabled on VCAT circuits that are diverse (split fiber) routed, and disabled on VCAT circuits that are common fiber routed.

Figure 5-9 shows the CE-1000-4 card faceplate and block diagram.

Figure 5-9 CE-1000-4 Faceplate and Block Diagram



5.10.1 CE-1000-4 Card-Level Indicators

The CE-1000-4 card faceplate has two card-level LED indicators, described in Table 5-19.

Table 5-19 CE-1000-4 Card-Level Indicators

Card-Level LEDs	Description
FAIL LED (Red)	The red FAIL LED indicates that the card processor is not ready or that a catastrophic software failure occurred on the CE-1000-4 card. As part of the boot sequence, the FAIL LED is turned on until the software deems the card operational.
ACT LED (Green)	The green ACT LED provides the operational status of the CE-1000-4 card. When the ACT LED is green, it indicates that the CE-1000-4 card is active and the software is operational.

Note If the CE-1000-4 card is inserted in a slot that has been preprovisioned for a different type of card, the red FAIL LED and the green ACT LED will flash alternately until the configuration mismatch is resolved.

5.10.2 CE-1000-4 Port-Level Indicators

The CE-1000-4 card provides a pair of LEDs for each Gigabit Ethernet port: an amber LED for activity (ACT) and a green LED for link status (LINK). Table Table 5-20 describes the status that each color represents.

Table 5-20 CE-1000-4 Port-Level Indicators

Port-Level Indicators	Description
Off	No link exists to the Ethernet port.
Steady amber	A link exists to the Ethernet port, but traffic flow is inhibited. For example, a lack of circuit setup, an error on the line, or a disabled port might inhibit traffic flow.
Solid green	A link exists to the Ethernet port, but no traffic is carried on the port.
Flashing green	A link exists to the Ethernet port, and traffic is carried on the port. The LED flash rate reflects the traffic rate for that port.

5.10.3 Cross-Connect and Slot Compatibility

The CE-1000-4 card can be installed in Slots 1 to 6 and 12 to 17 when used with the XC10G, XC-VXC-10G, and XC-VXL-10G cards. When the shelf uses the XCVT card, the CE-1000-4 card can only be installed in Slots 5, 6, 12, and 13.

5.11 Ethernet Card GBICs and SFPs

Note For specifications, see the "A.2 SFP and XFP Specifications" section on page A-3.

The ONS 15454 SDH Ethernet cards use industry standard small form-factor pluggable connectors (SFPs) and gigabit interface converter (GBIC) modular receptacles. The ML-Series Gigabit Ethernet cards use standard Cisco SFPs. The Gigabit E-Series, G-1K-4, and CE-1000-4 cards use standard Cisco GBICs. G-1K-4 cards can also be equipped with dense wavelength division multiplexing (DWDM) and coarse wavelength division multiplexing (CWDM) GBICs to function as Gigabit Ethernet transponders.

For all Ethernet cards, the type of GBIC or SFP plugged into the card appears in CTC and TL1. Cisco offers SFPs and GBICs as separate orderable products.

5.11.1 Compatibility by Card

Table 5-21 lists Cisco ONS 15454 SDH Ethernet cards with their compatible GBICs and SFPs.

Caution Use only GBICs and SFPs certified for use in Cisco Optical Networking Systems. The top assembly numbers (TANs) for each GBIC and SFP are provided in Table 5-21.

Table 5-21 GBIC and SFP Card Compatibility

Card	Compatible GBIC or SFP (Cisco Product ID)	Cisco Top Assembly Number (TAN)
E1000-2-G (ONS 15454 SONET) E1000-2 (ONS 15454 SONET/SDH)	15454-GBIC-SX 15454E-GBIC-SX 15454-GBIC-LX/LH 15454E-GBIC-LX/LH	30-0759-01 800-06780-01[1] 10-1743-01 30-0703-01
G1K-4 (ONS 15454 SONET/SDH) G1000-4 (ONS 15454 SONET/SDH)	15454-GBIC-SX 15454E-GBIC-SX 15454-GBIC-LX/LH 15454E-GBIC-LX/LH 15454-GBIC-ZX 15454E-GBIC-ZX 15454-GBIC-xx.x[2] 15454E-GBIC-xx.x[2] 15454-GBIC-xxxx[3] 15454E-GBIC-xxxx[3]	30-0759-01 800-06780-01 10-1743-01 30-0703-01 30-0848-01 10-1744-01 10-1845-01 through 10-1876-01 10-1845-01 through 10-1876-01 10-1453-01 through 10-1460-01 10-1453-01 through 10-1460-01
ML1000-2 (ONS 15454 SONET/SDH)	15454-SFP-LC-SX 15454E-SFP-LC-SX ONS-SC-GE-SX 15454-SFP-LC-LX/LH 15454E-SFP-LC-LX/LH ONS-SC-GE-LX	30-1301-01 30-1301-01 10-2301-01 30-1299-01 30-1299-01 10-2298-01
ML100X-8 (ONS 15454 SONET/SDH)	ONS-SE-100-FX ONS-SE-100-LX10	10-2212-01 10-2213-01
CE-1000-4 (ONS 15454 SONET/SDH)	15454-GBIC-SX 15454-GBIC-LX 15454-GBIC-ZX ONS-GC-GE-SX ONS-GC-GE-LX ONS-GC-GE-ZX	30-0759-01 10-1743-01 30-0848-01 10-2192-01 10-2191-01 10-2190-01

1. This TAN is only compatible with ONS 15454-E1000-2 or 15454-E1000-2-G cards.
2. xx.x defines the 32 possible wavelengths as shown in Table A-1 on page A-4.
3. xxxx defines the 8 possible wavelengths as shown in Table 5-22 on page 5-27.

5.11.2 GBIC Description

GBICs are integrated fiber-optic transceivers that provide high-speed serial links from a port or slot to the network. Various latching mechanisms can be used on the GBIC modules. There is no correlation between the type of latch and the model type (such as SX or LX/LH) or technology type (such as Gigabit Ethernet). See the label on the GBIC for technology type and model. One GBIC model has two clips (one on each side of the GBIC) that secure the GBIC in the slot on the Ethernet card; the other has a locking handle. Both types are shown in Figure 5-10.

GBIC dimensions are:

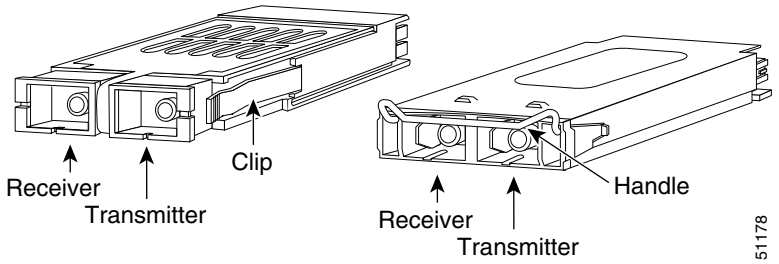
- Height 0.39 in. (1 cm)
- Width 1.18 in. (3 cm)

- Depth 2.56 in. (6.5 cm)

GBIC temperature ranges are:

- COM—commercial operating temperature range -5•C to 70•C
- EXT—extended operating temperature range 0•C to 85•C
- IND—industrial operating temperature range -40•C to 85•C

Figure 5-10 GBICs with Clips (left) and with a Handle (right)



5.11.3 DWDM and CWDM GBICs

DWDM (15454-GBIC-xx.x, 15454E-GBIC-xx.x) and CWDM (15454-GBIC-xxxx, 15454E-GBIC-xxxx) GBICs operate in the G-1K-4 card when the card is configured in Gigabit Ethernet Transponding mode or in Ethernet over SDH mode. DWDM and CWDM GBICs are both wavelength division multiplexing (WDM) technologies and operate over single-mode fibers with SC connectors. Cisco CWDM GBIC technology uses a 20 nm wavelength grid and Cisco ONS 15454 DWDM GBIC technology uses a 1 nm wavelength grid. CTC displays the specific wavelengths of the installed CWDM or DWDM GBICs. DWDM wavelengths are spaced closer together and require more precise lasers than CWDM. The DWDM spectrum allows for optical signal amplification. For more information on G-1K-4 card transponding mode, see the *Ethernet Card Software Feature and Configuration Guide for the Cisco ONS 15454, Cisco ONS 15454 SDH, and Cisco ONS 15327.*

The DWDM and CWDM GBICs receive across the full 1300 nm and 1500 nm bands, which includes all CWDM, DWDM, LX/LH, ZX wavelengths, but transmit on one specified wavelength. This capability can be exploited in some of the G-1K-4 transponding modes by receiving wavelengths that do not match the specific transmission wavelength.

Note G1K-4 cards with the Common Language Equipment Identification (CLEI) code of WM5IRWPCAA (manufactured after August 2003) support CWDM and DWDM GBICs. G1K-4 cards manufactured prior to August 2003 do not support CWDM or DWDM GBICs.

The ONS 15454-supported CWDM GBICs reach up to 100 to 120 km over single-mode fiber and support eight wavelengths as shown in Table 5-22.

Table 5-22 Supported Wavelengths for CWDM GBICs

CWDM GBIC Wavelengths	1470 nm	1490 nm	1510 nm	1530 nm	1550 nm	1570 nm	1590 nm	1610 nm
Corresponding GBIC Colors	Gray	Violet	Blue	Green	Yellow	Orange	Red	Brown
Band	47	49	51	53	55	57	59	61

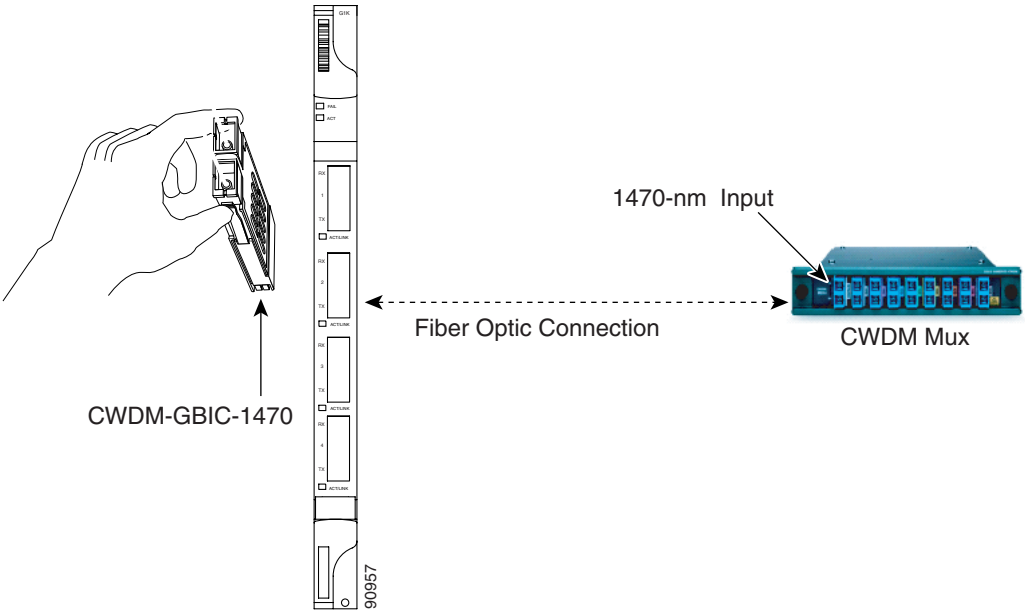
The ONS 15454-supported DWDM GBICs reach up to 100 to 120 km over single-mode fiber and support 32 different wavelengths in the red and blue bands. Paired with optical amplifiers, such as the Cisco ONS 15216, the DWDM GBICs allow maximum unregenerated spans of approximately 300 km (Table 5-23).

Table 5-23 Supported Wavelengths for DWDM GBICs

Blue Band	1530.33 nm	1531.12 nm	1531.90 nm	1532.68 nm	1534.25 nm	1535.04 nm	1535.82 nm	1536.61 nm
	1538.19 nm	1538.98 nm	1539.77 nm	1540.56 nm	1542.14 nm	1542.94 nm	1543.73 nm	1544.53 nm
Red Band	1546.12 nm	1546.92 nm	1547.72 nm	1548.51 nm	1550.12 nm	1550.92 nm	1551.72 nm	1552.52 nm
	1554.13 nm	1554.94 nm	1555.75 nm	1556.55 nm	1558.17 nm	1558.98 nm	1559.79 nm	1560.61 nm

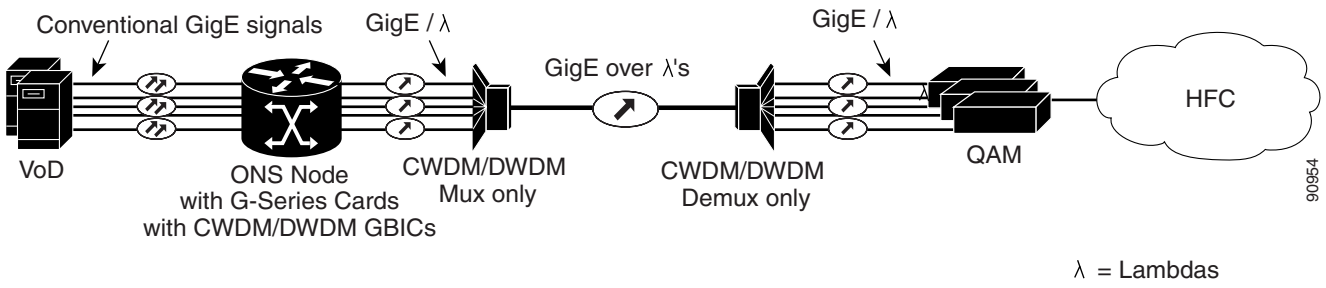
CWDM or DWDM GBICs for the G-1K-4 card come in set wavelengths and are not provisionable. The wavelengths are printed on each GBIC, for example, CWDM-GBIC-1490. The user must insert the specific GBIC transmitting the wavelength required to match the input of the CWDM/DWDM device for successful operation (Figure 5-11). Follow your site plan or network diagram for the required wavelengths.

Figure 5-11 CWDM GBIC with Wavelength Appropriate for Fiber-Connected Device



A G-1K-4 card equipped with CWDM or DWDM GBICs supports the delivery of unprotected Gigabit Ethernet service over Metro DWDM (Figure 5-12). It can be used in short-haul and long-haul applications.

Figure 5-12 G-1K-4 with CWDM/DWDM GBICs in Cable Network



5.11.4 SFP Description

SFPs are integrated fiber-optic transceivers that provide high speed serial links from a port or slot to the network. Various latching mechanisms can be utilized on the SFP modules. There is no correlation between the type of latch to the model type (such as SX or LX/LH) or technology type (such as Gigabit Ethernet). See the label on the SFP for technology type and model. One type of latch available is a mylar tab (Figure 5-13), a second type of latch available is an actuator/button (Figure 5-14), and a third type of latch is a bail clasp (Figure 5-15).

SFP dimensions are:

- Height 0.03 in. (8.5 mm)
- Width 0.53 in. (13.4 mm)
- Depth 2.22 in. (56.5 mm)

SFP temperature ranges for are:

- COM—commercial operating temperature range -5•C to 70•C
- EXT—extended operating temperature range -5•C to 85•C
- IND—industrial operating temperature range -40•C to 85•C

Figure 5-13 Mylar Tab SFP

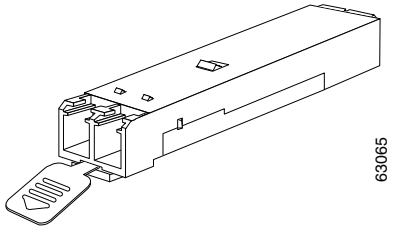


Figure 5-14 Actuator/Button SFP

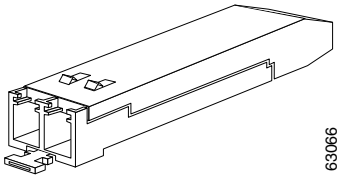
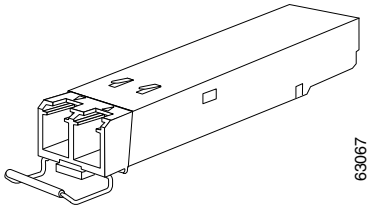


Figure 5-15 Bail Clasp SFP



CHAPTER 6

Storage Access Networking Cards

The Fibre Channel Multirate 4-Port (FC_MR-4) card is a 1.0625- or 2.125-Gbps Fibre Channel/fiber connectivity (FICON) card that integrates non-SDH framed protocols into an SDH time-division multiplexing (TDM) platform through virtually concatenated (VCAT) payloads. This chapter provides information about the FC_MR-4 card. For installation and step-by-step circuit configuration procedures, refer to the *Cisco ONS 15454 SDH Procedure Guide*.

Chapter topics include:

- 6.1 FC_MR-4 Card Overview, page 6-1
- 6.2 FC_MR-4 Card Modes, page 6-3
- 6.3 FC_MR-4 Card Application, page 6-6
- 6.4 FC_MR-4 Card GBICs, page 6-7

6.1 FC_MR-4 Card Overview

Note For specifications, see the "A.8.1 FC_MR-4 Card Specifications" section on page A-48.

The FC_MR-4 card uses pluggable Gigabit Interface Converters (GBICs) to transport non-SONET/SDH-framed, block-coded protocols over SONET/SDH. The FC_MR-4 enables four client Fibre Channel (FC) ports to be transported over SONET/SDH, encapsulating the frames using the ITU-T generic framing procedure (GFP) format and mapping them into either T1X1 G.707-based VCAT payloads or standard contiguously concatenated SONET/SDH payloads. The FC_MR-4 card has the following features:

- Four FICON ports operating at 1 Gbps or 2 Gbps
  - All four ports can be operational at any time due to subrate support
  - Advanced distance extension capability (buffer-to-buffer [B2B] credit spoofing)
- Pluggable GBIC optics
  - Dual rate (1G/2G): MM (550 m) and SM (10 km)
  - Single rate (1G): SX (550 m) and LX (10 km)
- SONET/SDH support
  - Four 1.0625-Gbps FC channels can be mapped into one of the following:

SONET containers as small as STS1-1v (subrate)
SDH containers as small as VC4-1v (subrate)
SONET/SDH containers as small as STS-18c/VC4-6v (full rate)

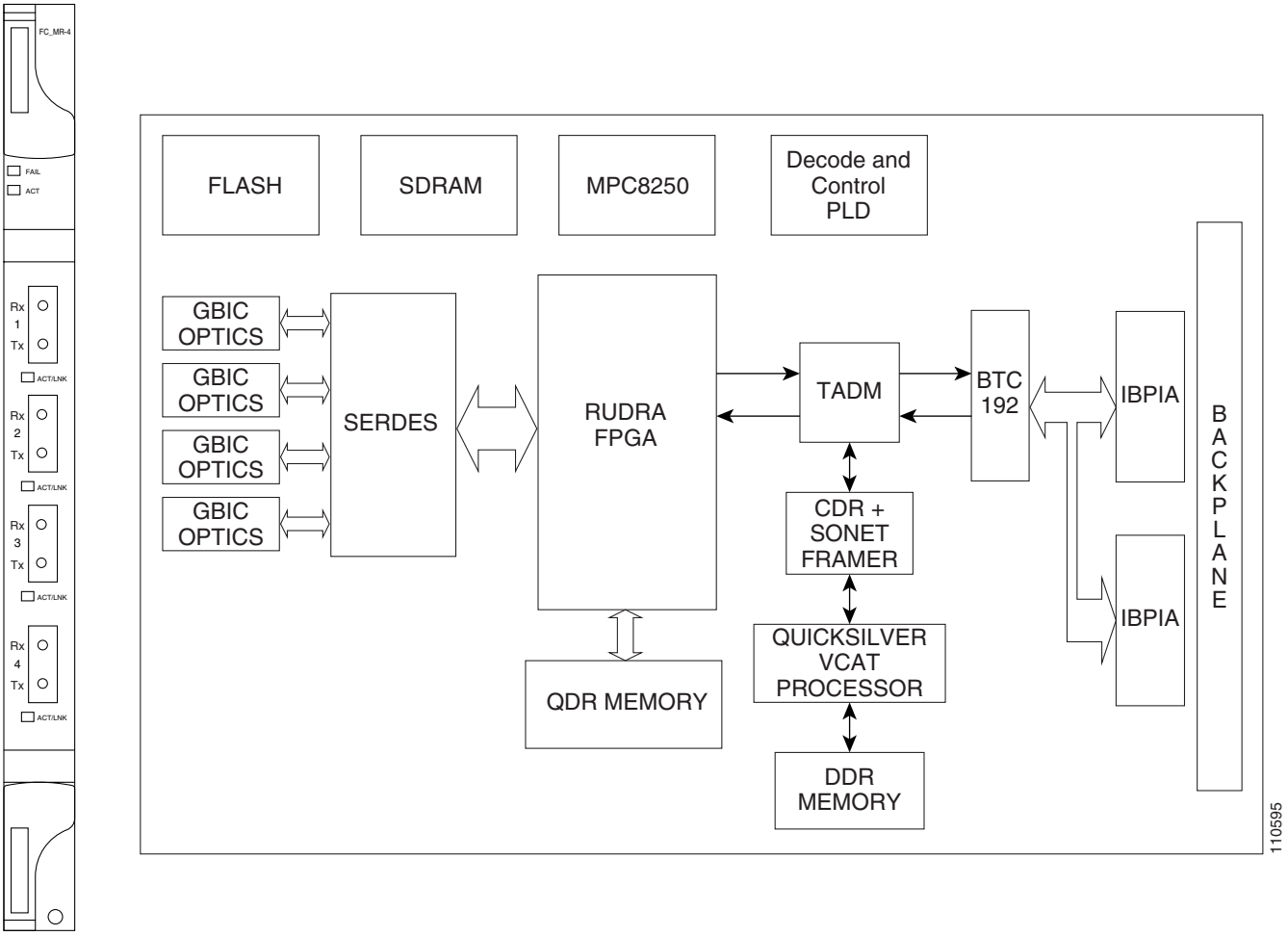
– Four 2.125 Gbps FC channels can be mapped into one of the following:

SONET containers as small as STS1-1v (subrate)
SDH containers as small as VC4-1v (subrate)
SONET/SDH containers as small as STS36c/VC4-12v (full rate)

- Frame encapsulation: ITU-T G.7041 transparent generic framing procedure (GFP-T)
- High-order SONET/SDH VCAT support (STS1-Xv and STS3c-Xv/VC4-Xv)
- Differential delay support for VCAT circuits

Figure 6-1 shows the FC_MR-4 faceplate and block diagram.

Figure 6-1 FC_MR-4 Faceplate and Block Diagram



6.1.1 FC_MR-4 Card-Level Indicators

Table 6-1 describes the two card-level LEDs on the FC_MR-4 card.

Table 6-1 FC_MR-4 Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. Replace the card if the red FAIL LED persists.
Green ACT LED	If the ACTV/STBY LED is green, the card is operational and ready to carry traffic.
Amber ACT LED	If the ACTV/STBY LED is amber, the card is rebooting.

6.1.2 FC_MR-4 Port-Level Indicators

Each FC_MR-4 port has a corresponding ACT/LNK LED. The ACT/LNK LED is solid green if the port is available to carry traffic, is provisioned as in-service, and is in the active mode. The ACT/LNK LED is flashing green if the port is carrying traffic. The ACT/LNK LED is steady amber if the port is not enabled and the link is connected, or if the port is enabled and the link is connected but there is an SONET/SDH transport error. The ACT/LNK LED is not lit if there is no link.

You can find the status of the card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

6.1.3 FC_MR-4 Compatibility

The FC_MR-4 cards can be installed in Slots 1 to 6 and 12 to 17 when used with XC-VXL-2.5G, XC-VXL-10G, and XC-VXC-10G cards. The FC_MR-4 card can be provisioned as part of any valid ONS 15454 SONET/SDH network topology, such as subnetwork connection protection ring (SNCP) (CCAT circuits only), multiplex section-shared protection ring (MS-SPRing), 1+1 subnetwork connection (SNC), unprotected, and linear network topologies. The FC_MR-4 card is compatible with Software Release 4.6 and greater.

6.2 FC_MR-4 Card Modes

The FC_MR-4 card can operate in two modes:

- Line rate mode. This mode is backward compatible with Software R4.6 line rate mode.
- Enhanced mode. This mode supports subrate, distance extension, differential delay, and other enhancements.

The FC_MR-4 card reboots when changing card modes (a traffic hit results). The FPGA running on the card upgrades to the required image. However, the FPGA image in the card's flash is not modified.

6.2.1 Line-Rate Card Mode

The mapping for the line rate card mode is summarized here.

- 1-Gbps Fibre Channel/FICON is mapped into:
  - STS24c, STS48c
  - VC4-8c, VC4-16c
  - STS1-Xv where X is 19 to 24
  - STS3c-Xv where X is 6 to 8
  - VC4-Xv where X is 6 to 8
- 2-Gbps Fibre Channel/FICON is mapped into:
  - STS48c
  - VC4-16c
  - STS1-Xv where X is 37 to 48
  - STS3c-Xv where X is 12 to 16
  - VC4-Xv where X is 12 to 16

6.2.2 Enhanced Card Mode

Features available in enhanced card mode are given in this section.

6.2.2.1 Mapping

1-Gbps Fibre Channel/FICON is mapped into:

- STS-1, STS-3c, STS-6c, STS-9c, STS-12c, STS-18c, STS-24c, STS-48c
- VC4-1c, VC4-2c, VC4-3c, VC4-4c, VC4-6c, VC4-8c, VC4-16c
- STS-1-Xv where X is 1 to 24
- STS-3c-Xv where X is 1 to 8
- VC4-Xv where X is 1 to 8

2-Gbps Fibre Channel/FICON is mapped into:

- STS-1, STS-3c, STS-6c, STS-9c, STS-12c, STS-18c, STS-24c, STS-36c, STS-48c
- VC4-1c, VC4-2c, VC4-3c, VC4-4c, VC4-6c, VC4-8c, VC4-12c, VC4-16c
- STS-1-Xv where X is 1 to 48
- STS-3c-Xv where X is 1 to 16
- VC4-Xv where X is 1 to 16

6.2.2.2 SW-LCAS

VCAT group (VCG) is reconfigurable when the software link capacity adjustment scheme (SW-LCAS) is enabled, as follows:

- Out-of-service (OOS) and out-of-group (OOG) members can be removed from the VCG.
- Members with deleted cross-connects can be removed from VCGs.
- Errored members can be autonomously removed from VCGs.
- Degraded bandwidth VCGs are supported.

- VCG is flexible when SW-LCAS is enabled. (VCG can run traffic as soon as the first cross-connect is provisioned on both sides of the transport.)

6.2.2.3 Distance Extension

This following list describes FC_MR-4 card distance extension capabilities:

- Enabling of a storage access networking (SAN) extension over long distances through B2B credit spoofing:
  - 2300 km for 1G ports (longer distances supported with lesser throughput)
  - 1150 km for 2G ports (longer distances supported with lesser throughput)
- Negotiation mechanism to identify if far-end FC-over-SONET card supports Cisco proprietary B2B mechanism.
- Autodetection of FC switch B2B credits from FC-SW standards-based ELP frames
- Support for manual provisioning of credits based on FC switch credits
- Automatic GFP buffer adjustment based on round trip latency between two SL ports
- Automatic credit recovery during SONET switchovers/failures
- Insulation for FC switches from any SONET switchovers. No FC fabric reconvergences for SONET failures of less than or equal to 60 ms.

6.2.2.4 Differential Delay Features

The combination of VCAT, SW-LCAS, and GFP specifies how to process information for data and storage clients. The resulting operations introduce delays. Their impact depends on the type of service being delivered. For example, storage requirements call for very low latency, as opposed to traffic such as e-mail, where latency variations are not critical.

With VCAT, SDH paths are grouped to aggregate bandwidth to form VCGs. Because each VCG member can follow a unique physical route through a network, there are differences in propagation delay, and possibly processing delays between members. The overall VCG propagation delay corresponds to that of the slowest member. The VCAT differential delay is the relative arrival time measurement between members of a VCG. The FC_MR-4 card is able to handle VCAT differential delay and provides these associated features:

- Supports a maximum of 122 ms of delay difference between the shortest and longest paths.
- Supports diverse fiber routing for VCAT circuit.
- All protection schemes are supported (SNCP [CCAT circuits only], MS-SPRing, protection channel access [PCA]).
- Supports routing of VCAT group members through different nodes in the SDH cloud.
- Differential delay compensation is automatically enabled on VCAT circuits that are diversely (split-fiber) routed, and disabled on VCAT circuits that are common-fiber routed.

Note Differential delay support for VCAT circuits is supported by means of a TL1 provisioning parameter (BUFFERS) in the ENT-VCG command.

6.2.2.5 Interoperability Features

The interoperability features are as follows:

- Maximum frame size setting to prevent accumulation of oversized performance monitoring (PM) parameters for virtual SAN (VSAN) frames
- Ingress filtering disabled for attachment to third-party GFP-over-SONET/SDH equipment

6.2.3 Link Integrity

The link integrity features are as follows:

- The data port is disabled if the upstream data port is not able to send over SONET/SDH transport.
- The data port is disabled if SONET/SDH transport is errored.

6.2.4 Link Recovery

Link recovery has the following features:

- Reduces the impact of SONET/SDH disruptions on attached Fibre Channel equipment
- Speeds up the recovery of Inter-Switch Links (ISLs)
- Allows the monitoring of B2B credit depletion due to SONET outage and the full recovery of the credits, thus preventing the slow decay of the bandwidth/throughput

Note Distance Extension and Link Recovery cannot be enabled at the same time.

6.3 FC_MR-4 Card Application

The FC_MR-4 card reliably transports carrier-class, private-line Fibre Channel/FICON transport service. Each FC_MR-4 card can support up to four 1-Gbps circuits or four 2-Gbps circuits. Four 1.0625-Gbps FC channels can be mapped into containers as small as STS-1 (subrate), with a minimum of STS-18c/VC4-6v for full rate. Four 2.125-Gbps FC channels can be mapped into containers as small as STS-1 (subrate), with a minimum of STS-36c/VC4-12v for full rate.

The FC_MR-4 card incorporates features optimized for carrier-class applications such as:

- Carrier-class Fibre Channel/FICON
- 50 ms of switch time through SONET/SDH protection as specified in Telcordia GR-253-CORE

Note Protection switch traffic hit times of less than 60 ms are not guaranteed with differential delay in effect.

- Hitless software upgrades

Note Hitless software upgrades are not possible with an activation from 5.0 to 6.0 in enhanced card mode. This is because the FPGA must be upgraded to support differential delay in enhanced mode. Upgrades are still hitless with the line rate mode.

- Remote Fibre Channel/FICON circuit bandwidth upgrades by means of integrated Cisco Transport Controller (CTC)
- Multiple management options through CTC, Cisco Transport Manager (CTM), TL1 (for SONET only), and Simple Network Management Protocol (SNMP)
- Differential delay compensation of up to 122 ms for diversely routed VCAT circuits

The FC_MR-4 payloads can be transported over the following protected circuit types, in addition to unprotected circuits:

- SNCP (CCAT circuits only)
- MS-SPRing
- PCA

The FC_MR-4 card supports high-order VCAT. See the "11.15 Virtual Concatenated Circuits" section on page 11-25 for more information about VCAT circuits.

6.4 FC_MR-4 Card GBICs

The FC_MR-4 uses pluggable GBICs for client interfaces. Table 6-2 lists the GBICs that are compatible with the FC_MR-4 card.

Table 6-2 GBIC Compatibility

Card	Compatible GBIC (Cisco Product ID)	Cisco Top Assembly Number (TAN)
FC_MR-4 (ONS 15454 SONET/SDH)	15454-GBIC-SX 15454E-GBIC-SX 15454-GBIC-LX/LH 15454E-GBIC-LX/LH ONS-GX-2FC-MMI ONS-GX-2FC-SML	30-0759-01 800-06780-01 10-1743-01 30-0703-01 10-2015-01 10-2016-01

Card Protection

This chapter explains the Cisco ONS 15454 SDH card protection configurations. To provision card protection, refer to the *Cisco ONS 15454 SDH Procedure Guide*.

Chapter topics include:

- 7.1 Electrical Card Protection, page 7-1
- 7.2 STM-N Card Protection, page 7-4
- 7.3 Unprotected Cards, page 7-4
- 7.4 External Switching Commands, page 7-5

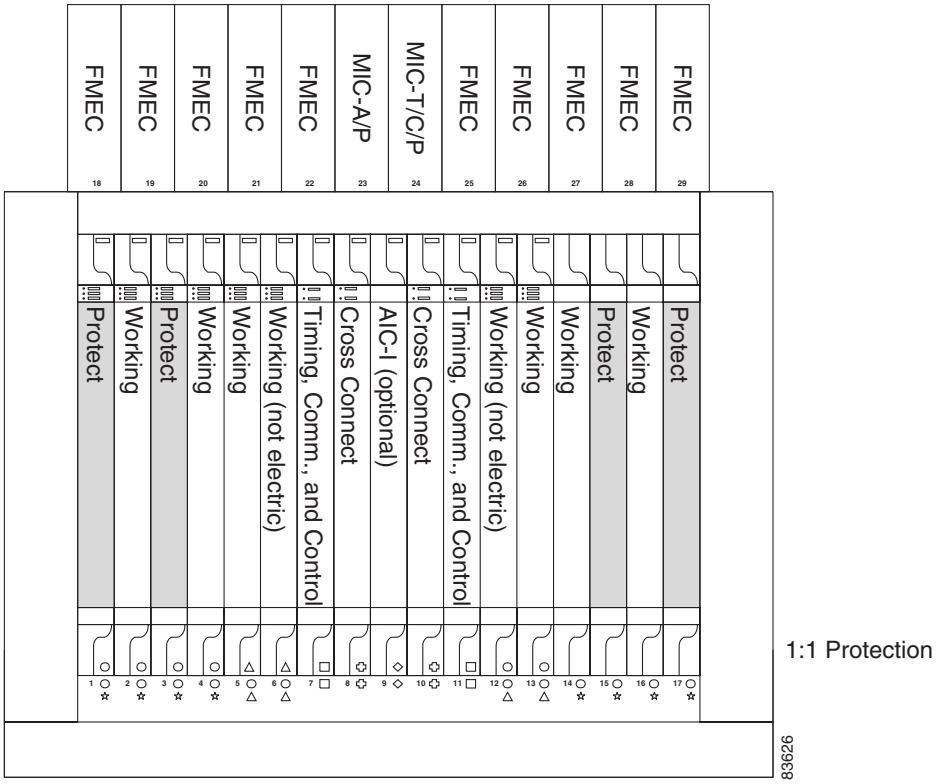
7.1 Electrical Card Protection

The ONS 15454 SDH provides a variety of electrical card protection methods. This section describes the protection options.

7.1.1 1:1 Protection

In 1:1 protection, a working card is paired with a protect card of the same type. If the working card fails, the traffic from the working card switches to the protect card.When the failure on the working card is resolved, traffic automatically reverts to the working card. Figure 7-1 shows the ONS 15454 SDH in a 1:1 protection configuration; Slot 2 is protecting Slot 1, Slot 4 is protecting Slot 3, Slot 17 is protecting Slot 16, and Slot 15 is protecting Slot 14. Each working card is paired with a protect card. Slots 6 and 12 are not used for electrical cards. They have no corresponding Front Mount Electrical Connection (FMEC) slots.

Figure 7-1 ONS 15454 SDH Cards in a 1:1 Protection Configuration



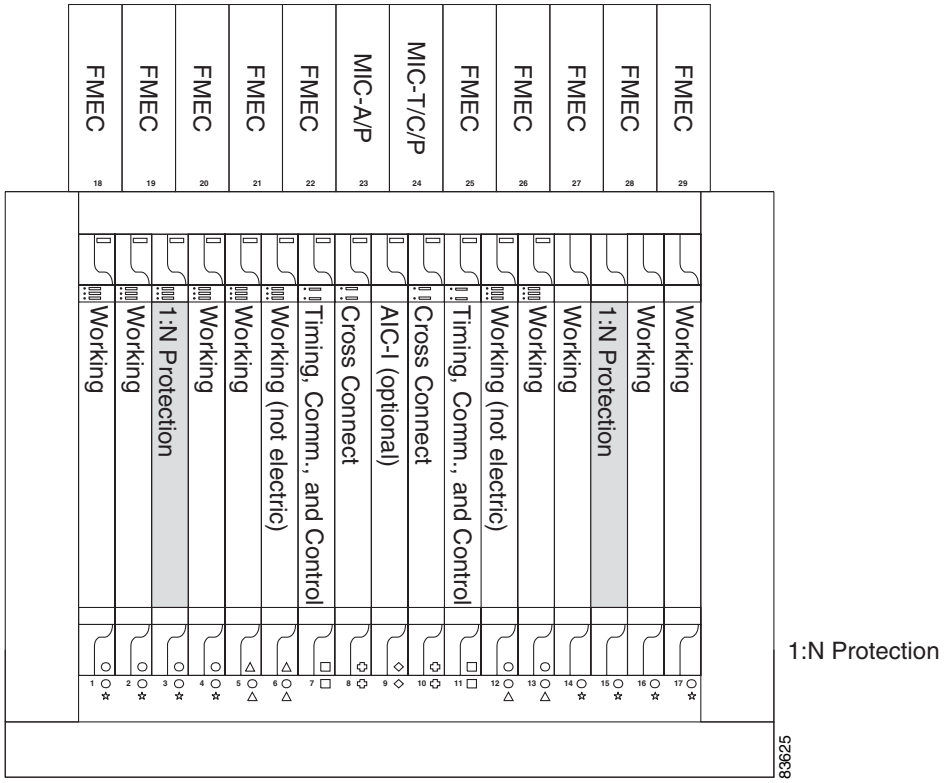
7.1.2 1:N Protection

1:N protection allows a single card to protect several working cards. An E1-N-14 card protects up to four E1-N-14 cards, and a DS3i-N-12 card protects up to four DS3i-N-12 cards.

Currently, 1:N protection operates only at the E-1, DS-3, and DS-1 levels. The 1:N protect cards must match the levels of their working cards. For example, an E1-N-14 protects only E1-N-14 cards, and a DS3i-N-12 protects only DS3i-N-12 cards.

The physical E-1, DS-3, or DS-1 ports on the ONS 15454 SDH FMEC cards use the working card until the working card fails. When the node detects this failure, the protect card takes over the physical E-1, DS-3, or DS-1 electrical interfaces through the relays and signal bridging on the backplane. Figure 7-2 shows the ONS 15454 SDH in a 1:N protection configuration. Each side of the shelf assembly has only one card protecting all of the cards on that side.

Figure 7-2 ONS 15454 SDH Cards in a 1:N Protection Configuration



7.1.2.1 Revertive Switching

1:N protection supports revertive switching. Revertive switching sends the electrical interfaces back to the original working card after the card comes back online. Detecting an active working card triggers the reversion process. There is a variable time period for the lag between detection and reversion, called the revertive delay, which you can set using Cisco Transport Controller (CTC). For instructions, refer to the *Cisco ONS 15454 SDH Procedure Guide.* All cards in a protection group share the same reversion settings. 1:N protection groups default to automatic reversion.

Caution A user-initiated switch (external switching command) overrides the revertive delay, that is, clearing the switch clears the timer.

7.1.2.2 1:N Protection Guidelines

Several rules apply to 1:N protection groups in the ONS 15454 SDH:

- Working and protect card groups must reside in the same card bank (A or B).
- The 1:N protect card must reside in Slot 3 for side A and Slot 15 for side B.
- Working cards might sit on either or both sides of the protect card.

The ONS 15454 SDH supports 1:N equipment protection for all add/drop multiplexer configurations (ring, linear, and terminal), as specified by ITU-T G.841.

The ONS 15454 SDH automatically detects and identifies a 1:N protect card when the card is installed in Slot 3 or Slot 15. However, the slot containing the 1:N card in a protection group must be manually provisioned as a protect slot because by default, all cards are working cards.

7.2 STM-N Card Protection

With 1+1 port-to-port protection, any number of ports on the protect card can be assigned to protect the corresponding ports on the working card. The working and protect cards do not have to be placed side by side in the node. A working card must be paired with a protect card of the same type and number of ports. For example, a single-port STM-4 must be paired with another single-port STM-4, and a four-port STM-4 must be paired with another four-port STM-4. You cannot create a 1+1 protection group if one card is single-port and the other is multiport, even if the STM-N rates are the same. The protection takes place on the port level, any number of ports on the protect card can be assigned to protect the corresponding ports on the working card.

For example, on a four-port card, you can assign one port as a protection port on the protect card (protecting the corresponding port on the working card) and leave three ports unprotected. Conversely, you can assign three ports as protection ports and leave one port unprotected.

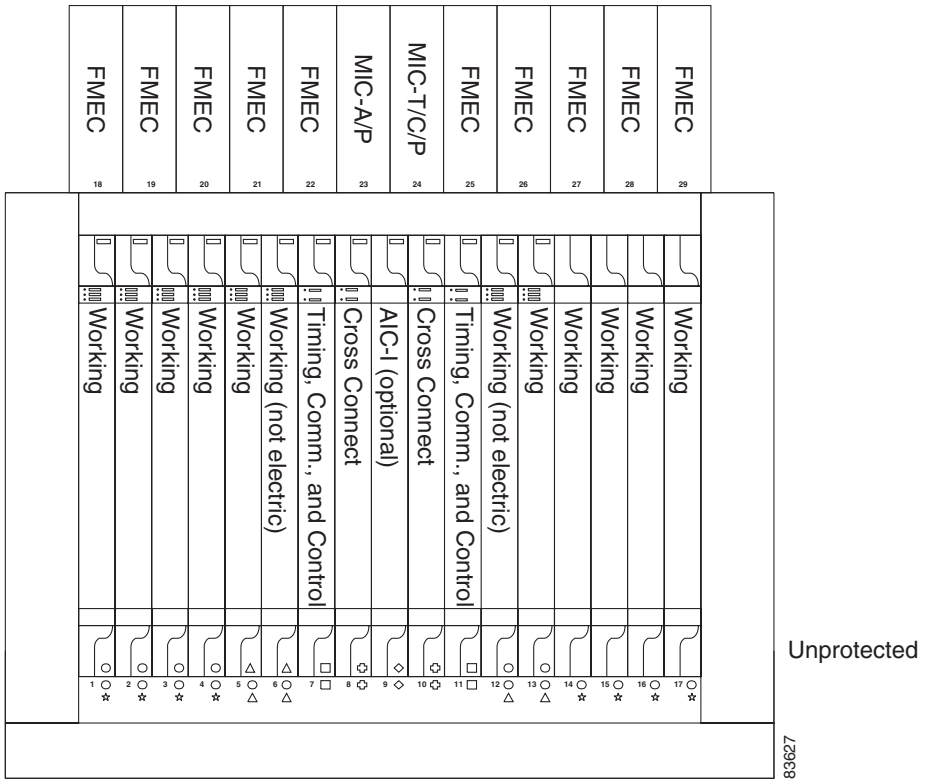
1+1 span protection can be either revertive or nonrevertive. With nonrevertive 1+1 protection, when a failure occurs and the signal switches from the working card to the protect card, the signal stays switched to the protect card until it is manually switched back. Revertive 1+1 protection automatically switches the signal back to the working card when the working card comes back online.

You create and modify protection schemes using CTC software. For more information, refer to the "Turn Up Node" chapter in the *Cisco ONS 15454 SDH Procedure Guide*.

7.3 Unprotected Cards

Unprotected cards are not included in a protection scheme; therefore, a card failure or a signal error results in lost data. An unprotected configuration is sometimes called 1:0 protection. Because no bandwidth is reserved for protection, unprotected schemes maximize the available ONS 15454 SDH bandwidth. Figure 7-3 shows the ONS 15454 SDH in an unprotected configuration. All cards are in a working state.

Figure 7-3 ONS 15454 SDH Cards in an Unprotected Configuration



7.4 External Switching Commands

The external switching commands on the ONS 15454 SDH are Manual, Force, and lockout. If you choose a Manual switch, the command will switch traffic only if the path has an error rate less than the signal degrade (SD) bit error rate threshold. A Force switch will switch traffic even if the path has SD or signal fail (SF) conditions; however, a Force switch will not override an SF on a 1+1 protection channel. A Force switch has a higher priority than a Manual switch. Lockouts, which prevent traffic from switching to the protect port under any circumstance, can only be applied to protect cards (in 1+1 configurations). Lockouts have the highest priority.

Note Force and Manual switches do not apply to 1:1 protection groups; these ports have a single switch command.

Another way to inhibit protection switching in a 1+1 configuration is to apply a lock-on to the working port. A working port with a lock-on applied cannot switch traffic to the protect port in the protection group (pair). In 1:1 protection groups, working or protect ports can have a lock-on.

Cisco Transport Controller Operation

This chapter describes Cisco Transport Controller (CTC), the Cisco software interface for the Cisco ONS 15454 SDH. For CTC set up and login information, refer to the *Cisco ONS 15454 SDH Procedure Guide*.

Chapter topics include:

- 8.1 CTC Software Delivery Methods, page 8-1
- 8.2 CTC Installation Overview, page 8-4
- 8.3 PC and UNIX Workstation Requirements, page 8-4
- 8.4 ONS 15454 SDH Connection, page 8-6
- 8.5 CTC Window, page 8-7
- 8.6 TCC2/TCC2P Card Reset, page 8-17
- 8.7 TCC2/TCC2P Card Database, page 8-17
- 8.8 Software Revert, page 8-17

8.1 CTC Software Delivery Methods

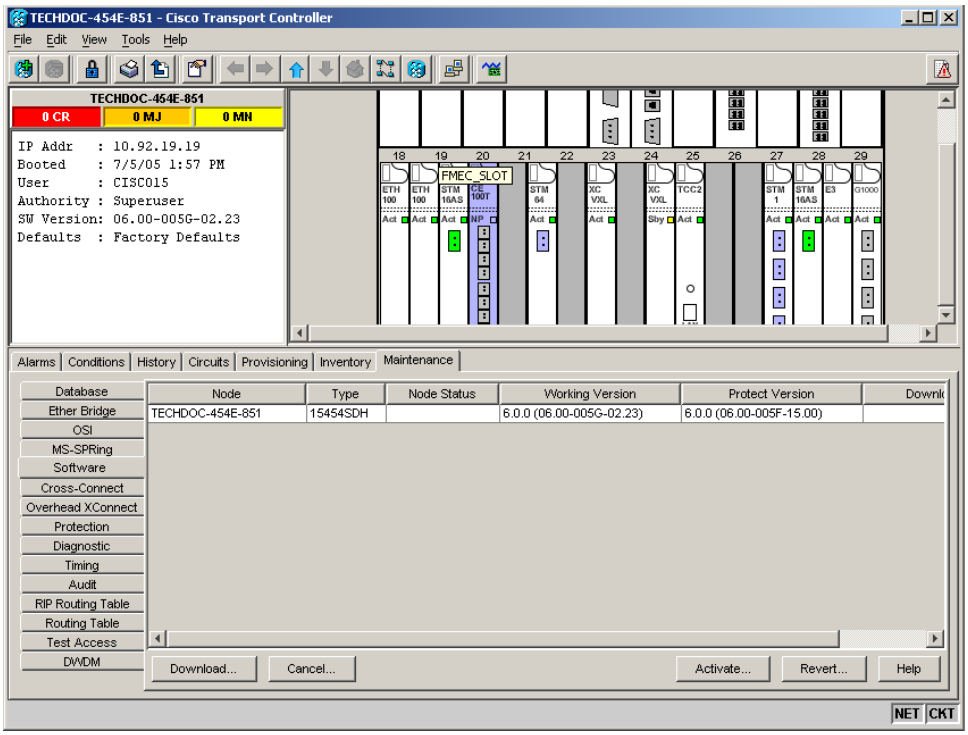
ONS 15454 SDH provisioning and administration is performed using the CTC software. CTC is a Java application that is installed in two locations; CTC is stored on the Advanced Timing, Communications, and Control (TCC2) card or the Advanced Timing, Communications, and Control Plus (TCC2P) card, and it is downloaded to your workstation the first time you log into the ONS 15454 SDH with a new software release.

8.1.1 CTC Software Installed on the TCC2/TCC2P Card

CTC software is preloaded on the ONS 15454 SDH TCC2/TCC2P card; therefore, you do not need to install software on the TCC2/TCC2P cards. When a new CTC software version is released, use the release-specific software upgrade guide to upgrade the ONS 15454 SDH software on the TCC2/TCC2P cards.

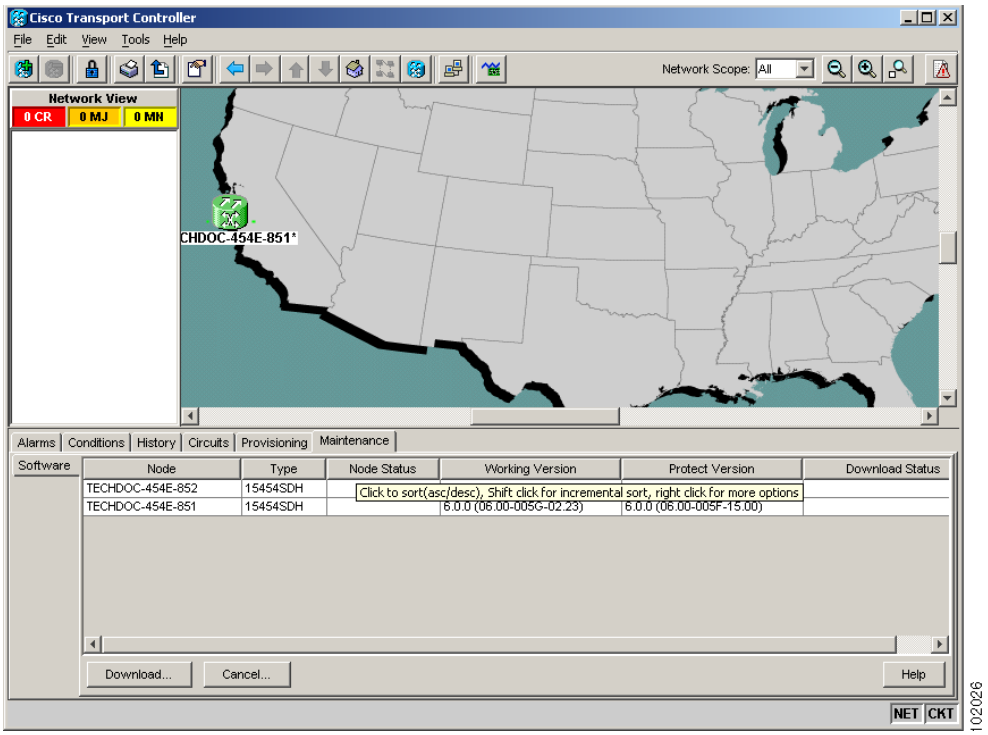
When you upgrade CTC software, the TCC2/TCC2P cards store the new CTC version as the protect CTC version. When you activate the new CTC software, the TCC2/TCC2P cards store the older CTC version as the protect CTC version, and the newer CTC release becomes the working version. You can view the software versions that are installed on an ONS 15454 SDH by selecting the Maintenance > Software tabs in node view (Figure 8-1).

Figure 8-1 CTC Software Versions, Node View



Select the Maintenance > Software tabs in network view to display the software versions installed on all the network nodes (Figure 8-2).

Figure 8-2 CTC Software Versions, Network View


Cisco Transport Controller
File Edit View Tools Help
Network Scope: All
Network View
0 CR 0 MJ 0 MN
CHDOC-454E-851
Alarms Conditions History Circuits Provisioning Maintenance
Software
Node Type Node Status Working Version Protect Version Download Status
TECHDOC-454E-852 15454SDH
TECHDOC-454E-851 15454SDH 6.0.0 (06.00-005G-02.23) 6.0.0 (06.00-005F-15.00)
Click to sort(asc/desc), Shift click for incremental sort, right click for more options
Download... Cancel... Help
NET CKT
102026

8.1.2 CTC Software Installed on the PC or UNIX Workstation

CTC software is downloaded from the TCC2/TCC2P cards and installed on your computer automatically after you connect to the ONS 15454 SDH with a new software release for the first time. Downloading the CTC software files automatically ensures that your computer is running the same CTC software version as the TCC2/TCC2P cards you are accessing. The computer CTC software files are stored in the temporary directory designated by your computer's operating system. You can use the Delete CTC Cache button to remove files stored in the temporary directory. If the files are deleted, they download the next time you connect to an ONS 15454 SDH. Downloading the Java archive files, called "JAR" files, for CTC takes several minutes depending on the bandwidth of the connection between your workstation and the ONS 15454 SDH. For example, JAR files downloaded from a modem or a data communication channel (DCC) network link require more time than JAR files downloaded over a LAN connection.

During network topology discovery, CTC polls each node in the network to determine which one contains the most recent version of the CTC software. If CTC discovers a node in the network that has a more recent version of the CTC software than the version you are currently running, CTC generates a message stating that a later version of the CTC has been found in the network and offers to install the CTC software upgrade. If you have network discovery disabled, CTC will not seek more recent versions of the software. Unreachable nodes are not included in the upgrade discovery.

Note Upgrading the CTC software will overwrite your existing software. You must restart CTC after the upgrade is complete.

8.2 CTC Installation Overview

To connect to an ONS 15454 SDH using CTC, you enter the ONS 15454 SDH IP address in the URL field of Netscape Communicator or Microsoft Internet Explorer. After connecting to an ONS 15454 SDH, the following occurs automatically:

1. A CTC launcher applet is downloaded from the TCC2/TCC2P card to your computer.
2. The launcher determines whether your computer has a CTC release matching the release on the ONS 15454 SDH TCC2/TCC2P card.
3. If the computer does not have CTC installed, or if the installed release is older than the TCC2/TCC2P card's version, the launcher downloads the CTC program files from the TCC2/TCC2P card.
4. The launcher starts CTC. The CTC session is separate from the web browser session, so the web browser is no longer needed. Always log into nodes having the latest software release. If you log into an ONS 15454 SDH that is connected to ONS 15454 SDHs with older versions of CTC, CTC files are downloaded automatically to enable you to interact with those nodes. The CTC file download occurs only when necessary, such as during your first login. You cannot interact with nodes on the network that have a software version later than the node that you used to launch CTC.

Each ONS 15454 SDH can handle up to five concurrent CTC sessions. CTC performance can vary, depending upon the volume of activity in each session, network bandwidth, and TCC2/TCC2P card load.

8.3 PC and UNIX Workstation Requirements

To use CTC in the ONS 15454 SDH, your computer must have a web browser with the correct Java Runtime Environment (JRE) installed. The correct JRE for each CTC software release is included on the ONS 15454 SDH software CD. If you are running multiple CTC software releases on a network, the JRE installed on the computer must be compatible with the different software releases.

Table 8-1 shows JRE compatibility with ONS software releases.

Table 8-1 JRE Compatibility

ONS Software Release	JRE 1.2.2 Compatible	JRE 1.3 Compatible	JRE 1.4 Compatible	JRE 5.0 Compatible
ONS 15454 SDH Release 3.3	Yes	Yes	No	No
ONS 15454 SDH Release 3.4	No	Yes	No	No
ONS 15454 SDH Release 4.0[1]	No	Yes	No	No
ONS 15454 SDH Release 4.1	No	Yes	No	No
ONS 15454 SDH Release 4.5	No	Yes	No	No
ONS 15454 SDH Release 4.6	No	Yes	Yes	No
ONS 15454 SDH Release 4.7	No	Yes	Yes	No
ONS 15454 SDH Release 5.0	No	No	Yes	No
ONS 15454 SDH Release 6.0	No	No	Yes	No
ONS 15454 SDH Release 7.0	No	No	Yes	Yes

1. Software releases 4.0 and later notify you if an older version of the JRE is running on your PC or UNIX workstation.

Note To avoid network performance issues, Cisco recommends managing a maximum of 50 nodes concurrently with CTC. The 50 nodes can be on a single DCC or split across multiple DCCs. Cisco does not recommend running multiple CTC sessions when managing two or more large networks.

To manage more than 50 nodes, Cisco recommends using Cisco Transport Manager (CTM). If you do use CTC to manage more than 50 nodes, you can improve performance by adjusting the heap size; see the "General Troubleshooting" chapter of the *Cisco ONS 15454 SDH Troubleshooting Guide.* You can also create login node groups; see the "Connect the PC and Log Into the GUI" chapter of the *Cisco ONS 15454 SDH Procedure Guide*.

Table 8-2 lists the requirements for PCs and UNIX workstations. In addition to the JRE, the Java plug-in is also included on the ONS 15454 SDH software CD.

Table 8-2 CTC Computer Requirements

Area	Requirements	Notes
Processor (PC only)	Pentium 4 processor or equivalent	A faster CPU is recommended if your workstation runs multiple applications or if CTC manages a network with a large number of nodes and circuits.
RAM	512 MB or more	A minimum of 1 GB is recommended if your workstation runs multiple applications or if CTC manages a network with a large number of nodes and circuits.
Hard drive	20 GB hard drive with 50 MB of space available	CTC application files are downloaded from the TCC2/TCC2P to your computer's Temp directory. These files occupy 5 to 10 MB of hard drive space.
Operating system	• PC: Windows 98, Windows NT 4.0, Windows 2000, or Windows XP • Workstation: Ultra 10 Sun running SunOS 6, 7, or 8	—

Table 8-2 CTC Computer Requirements (continued)

Area	Requirements	Notes
Java Runtime Environment	JRE 1.4.2 or JRE 5.0	JRE 1.4.2 is installed by the CTC Installation Wizard included on the Cisco ONS 15454 software CD. JRE 1.4.2 and JRE 5.0 provide enhancements to CTC performance, especially for large networks with numerous circuits. Cisco recommends that you use JRE 1.4.2 or JRE 5.0 for networks with Software R7.0 nodes. If CTC must be launched directly from nodes running software R5.0, or R6.0, Cisco recommends JRE 1.4.2.If CTC must be launched directly from nodes running software earlier than R5.0, Cisco recommends JRE 1.3.1_02.
Web browser	• PC:Internet Explorer 6.x or Netscape 7.x • UNIX Workstation: Mozilla 1.7, Netscape 4.76, Netscape 7.x	For the PC, use JRE 1.4.2 or JRE 5.0 with any supported web browser. Cisco recommends Internet Explorer 6.x. For UNIX, use JRE 5.0 with Netscape 7.x or JRE 1.3.1_02 with Netscape 4.76. Netscape 4.76 or 7.x is available at the following site: http://channels.netscape.com/ns/browsers/default.jsp Internet Explorer 6.x is available at the following site: http://www.microsoft.com
Cable	User-supplied Category 5 straight-through cable with RJ-45 connectors on each end to connect the computer directly to the ONS 15454 SDH or through a LAN	—

8.4 ONS 15454 SDH Connection

You can connect to the ONS 15454 SDH in multiple ways. You can connect your PC directly the ONS 15454 SDH (local craft connection) using the RJ-45 port on the TCC2/TCC2P card, to the LAN pins on the MIC-C/T/P, or by connecting your PC to a hub or switch that is connected to the ONS 15454 SDH. You can connect to the ONS 15454 SDH through a LAN or modem, and you can establish TL1 connections from a PC or TL1 terminal. Table 8-3 lists the ONS 15454 SDH connection methods and requirements.

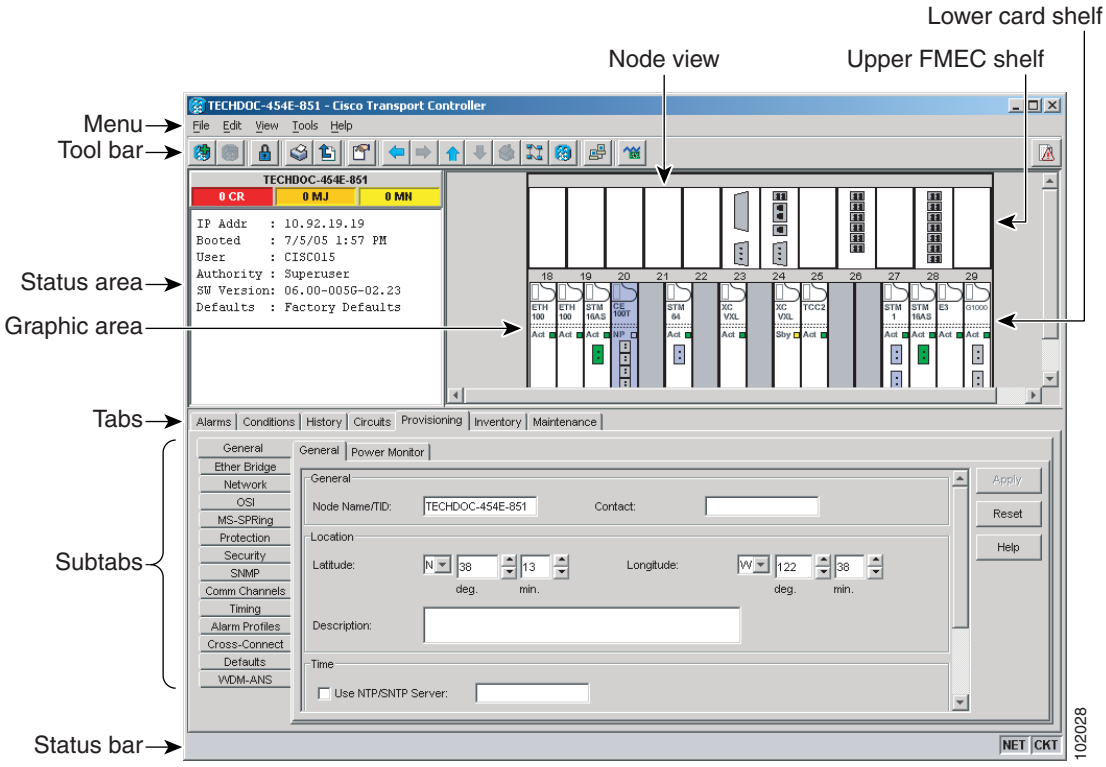
Table 8-3 ONS 15454 SDH Connection Methods

Method	Description	Requirements
Local craft	Refers to onsite network connections between the CTC computer and the ONS 15454 SDH using one of the following: • The RJ-45 (LAN) port on the TCC2/TCC2P card • The LAN pins on the ONS 15454 SDH MIC-C/T/P FMEC • A hub or switch to which the ONS 15454 SDH is connected	• If you do not use Dynamic Host Configuration Protocol (DHCP), you must change the computer IP address, subnet mask, and default router, or use automatic host detection.
Corporate LAN	Refers to a connection to the ONS 15454 SDH through a corporate or network operations center (NOC) LAN.	• The ONS 15454 SDH must be provisioned for LAN connectivity, including IP address, subnet mask, default gateway. • The ONS 15454 SDH must be physically connected to the corporate LAN. • The CTC computer must be connected to the corporate LAN that has connectivity to the ONS 15454 SDH.
TL1	Refers to a connection to the ONS 15454 SDH using TL1 rather than CTC. TL1 sessions can be started from CTC, or you can use a TL1 terminal. The physical connection can be a craft connection, corporate LAN, or a TL1 terminal. Refer to the *Cisco ONS 15454 SDH TL1 Reference Manual* for more information about TL1.	—
Remote	Refers to a connection made to the ONS 15454 SDH using a modem.	• A modem must be connected to the ONS 15454 SDH. • The modem must be provisioned for ONS 15454 SDH. To run CTC, the modem must be provisioned for Ethernet access.

8.5 CTC Window

The CTC window appears after you log into an ONS 15454 SDH (Figure 8-3). The window includes a menu bar, toolbar, and a top and bottom pane. The top pane provides status information about the selected objects and a graphic of the current view. The bottom pane provides tabs and subtabs to view ONS 15454 SDH information and perform ONS 15454 SDH provisioning and maintenance. From this window you can display three ONS 15454 SDH views: network, node, and card.

Figure 8-3 Node View (Default Login View)



8.5.1 Node View

Node view, shown in Figure 8-3, is the first view open after you log into an ONS 15454 SDH. The login node is the first node shown, and it is the "home view" for the session. Node view allows you to view and manage one ONS 15454 SDH node. The status area shows the node name; IP address; session boot date and time; number of Critical (CR), Major (MJ), and Minor (MN) alarms; the name of the current logged-in user; and the security level of the user; software version; and the network element default setup.

8.5.1.1 CTC Card Colors

The graphic area of the CTC window depicts the ONS 15454 SDH shelf assembly. The colors of the cards in the graphic reflect the real-time status of the physical card and slot (Table 8-4).

Table 8-4 Node View Card Colors

Card Color	Status
Gray	Slot is not provisioned; no card is installed.
Violet	Slot is provisioned; no card is installed.
White	Slot is provisioned; a functioning card is installed.
Yellow	Slot is provisioned; a Minor alarm condition exists.

Table 8-4 Node View Card Colors (continued)

Card Color	Status
Orange	Slot is provisioned; a Major alarm condition exists.
Red	Slot is provisioned; a Critical alarm exists.

The colors of the Front Mount Electrical Connection (FMEC) cards reflect the real-time status of the physical FMEC cards. Table 8-5 lists the FMEC card colors. The FMEC ports shown in CTC do not change color.

Note You cannot preprovision FMECs.

Table 8-5 Node View FMEC Color

Upper Shelf FMEC Color	Status
White	Functioning card is installed.
Yellow	Minor alarm condition exists.
Orange (Amber)	Major alarm condition exists.
Red	Critical alarm exists.

Port color in both card and node view indicates the port service state. Table 8-6 lists the port colors and their service states. For more information about port service states, see Appendix B, "Administrative and Service States."

Table 8-6 Node View Card Port Colors and Service States

Port Color	Service State	Description
Blue	Locked-enabled,loopback	Port is in a loopback state. On the card in node view, a line between ports indicates that the port is in terminal or facility loopback (see Figure 8-4 on page 8-10 and Figure 8-5 on page 8-10). Traffic is carried and alarm reporting is suppressed. Raised fault conditions, whether or not their alarms are reported, can be retrieved on the CTC Conditions tab or by using the TL1 RTRV-COND command.
Blue	Locked-enabled, maintenance	Port is out-of-service for maintenance. Traffic is carried and loopbacks are allowed. Alarm reporting is suppressed. Raised fault conditions, whether or not their alarms are reported, can be retrieved on the CTC Conditions tab or by using the TL1 RTRV-COND command. Use Locked-enabled,maintenance for testing or to suppress alarms temporarily. Change the state to Unlocked-enabled; Locked-enabled,disabled; or Unlocked-disabled,automaticInService when testing is complete.
Gray	Locked-enabled,disabled	The port is out-of-service and unable to carry traffic. Loopbacks are not allowed in this service state.

Table 8-6 Node View Card Port Colors and Service States (continued)

Port Color	Service State	Description
Green	Unlocked-enabled	The port is fully operational and performing as provisioned. The port transmits a signal and displays alarms; loopbacks are not allowed.
Violet	Unlocked-disabled, automaticInService	The port is out-of-service, but traffic is carried. Alarm reporting is suppressed. The node monitors the ports for an error-free signal. After an error-free signal is detected, the port stays in this state for the duration of the soak period. After the soak period ends, the port service state changes to Unlocked-enabled. Raised fault conditions, whether or not their alarms are reported, can be retrieved on the CTC Conditions tab or by using the TL1 RTRV-COND command. The AINS port will automatically transition to Unlocked-enabled when a signal is received for the length of time provisioned in the soak field.

Figure 8-4 Terminal Loopback Indicator

Figure 8-5 Facility Loopback Indicator

8.5.1.2 Card and Port States

The wording on a lower-shelf card in node view shows the status of a card (Active, Standby, Loading, or Not Provisioned). Table 8-7 lists the card states.

Table 8-7 Node View Card States

Lower Shelf Card Status	Description
Sty	Card is in standby.
Act	Card is active.
NP	Card is not present.
Ldg	Card is resetting.

The graphics on a port in node view show the state of a port (diagonal lines or loop graphics). Table 8-8 lists the port graphic and their description.

Table 8-8 Node View Port Graphics

Lower Shelf Port Graphics	Description
Multiple diagonal lines on port	Port is in service and card was reset.
Loop graphic on port	Port is in service and has a loopback provisioned in Card View > Maintenance > Loopback tabs.

8.5.1.3 Node View Card Shortcuts

If you move your mouse over cards in the graphic, popups display additional information about the card including the card type; the card status (active or standby); the type of alarm, such as Critical, Major, and Minor (if any); and the alarm profile used by the card. Right-click a card to reveal a shortcut menu, which you can use to open, reset, or delete a card. Right-click a slot to preprovision a card (that is, provision a slot before installing the card).

8.5.1.4 Node View Tabs

Table 8-9 lists the tabs and subtabs available in the node view.

Table 8-9 Node View Tabs and Subtabs

Tab	Description	Subtabs
Alarms	Lists current alarms (CR, MJ, MN) for the node and updates them in real time.	—
Conditions	Displays a list of standing conditions on the node.	—
History	Provides a history of node alarms including date, type, and severity of each alarm. The Session subtab displays alarms and events for the current session. The Node subtab displays alarms and events retrieved from a fixed-size log on the node.	Session, Node
Circuits	Creates, deletes, edits, and maps circuits.	—
Provisioning	Provisions the ONS 15454 SDH node.	General, Ether Bridge, Network, OSI, MS-SPRing, Protection, Security, SNMP, Comm Channels, Timing, Alarm Profiles, Cross-Connect, Defaults, WDM-ANS

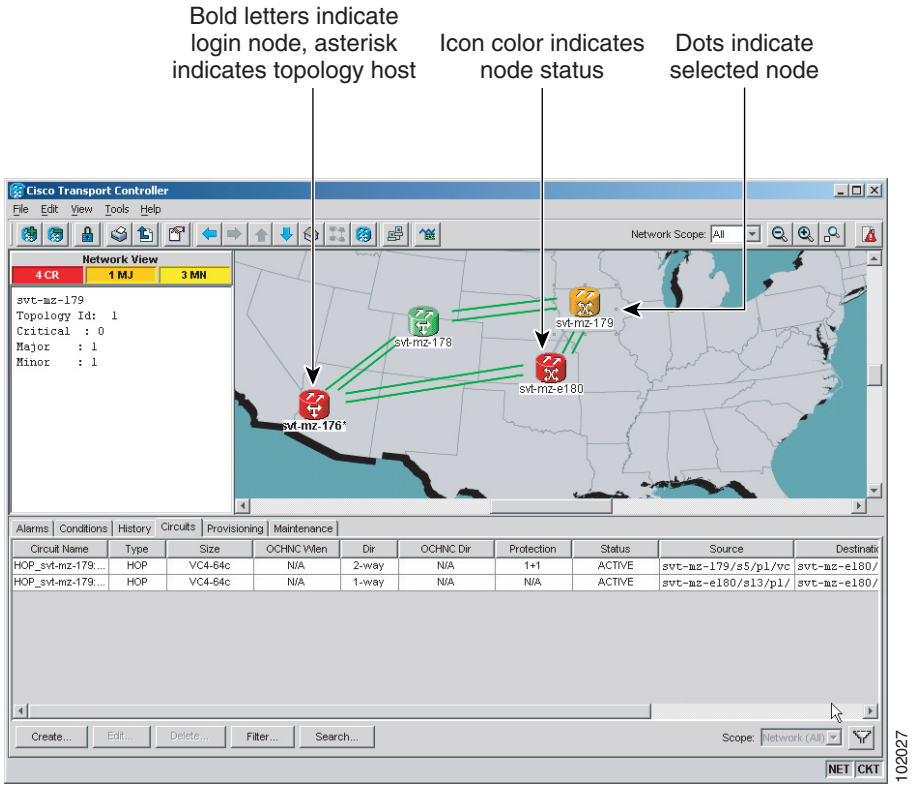
Table 8-9 Node View Tabs and Subtabs (continued)

Tab	Description	Subtabs
Inventory	Provides inventory information (part number, serial number, CLEI codes) for cards installed in the node. Allows you to delete and reset cards.	—
Maintenance	Performs maintenance tasks for the node.	Database, Ether Bridge, OSI, MS-SPRing, Software, Cross-Connect, Overhead XConnect, Protection, Diagnostic, Timing, Audit, RIP Routing Table, Routing Table, Test Access, DWDM

8.5.2 Network View

Network view allows you to view and manage ONS 15454 SDHs that have DCC connections to the node that you logged into and any login node groups you selected (Figure 8-6).

Figure 8-6 CTC Network View


Bold letters indicate login node, asterisk indicates topology host
Icon color indicates node status
Dots indicate selected node
Cisco Transport Controller
File Edit View Tools Help
Network Scope: All
Network View
4 CR 1 MJ 3 MN
svt-mz-179
Topology Id: 1
Critical : 0
Major : 1
Minor : 1
svt-mz-178
svt-mz-179
svt-mz-e180
svt-mz-176*
Alarms Conditions History Circuits Provisioning Maintenance
Circuit Name Type Size OCHNC Wlen Dir OCHNC Dir Protection Status Source Destinati
HOP_svt-mz-179:... HOP VC4-64c N/A 2-way N/A 1+1 ACTIVE svt-mz-179/s5/pl/vc svt-mz-e180/
HOP_svt-mz-179:... HOP VC4-64c N/A 1-way N/A N/A ACTIVE svt-mz-e180/s13/pl/ svt-mz-e180/
Create... Edit... Delete... Filter... Search...
Scope: Network (All)
NET CKT
102027

Note Nodes with DCC connections to the login node do not appear if you checked the Disable Network Discovery check box in the Login dialog box.

The graphic area displays a background image with colored ONS 15454 SDH icons. A Superuser can set up the logical network view feature, which enables each user to see the same network view. Selecting a node or span in the graphic area displays information about the node and span in the status area.

8.5.2.1 CTC Node Colors

The color of a node in network view, shown in Table 8-10, indicates the node alarm status.

Table 8-10 Node Status Shown in Network View

Color	Alarm Status
Green	No alarms
Yellow	Minor alarms
Orange	Major alarms
Red	Critical alarms
Gray with Unknown#	Node initializing for the first time (CTC displays Unknown# because CTC has not discovered the name of the node yet)

8.5.2.2 Network View Tabs

Table 8-11 lists the tabs and subtabs available in network view.

Table 8-11 Network View Tabs and Subtabs

Tab	Description	Subtabs
Alarms	Lists current alarms (CR, MJ, MN) for the network and updates them in real time.	—
Conditions	Displays a list of standing conditions on the network.	—
History	Provides a history of network alarms including date, type, and severity of each alarm.	—
Circuits	Creates, deletes, edits, filters, and searches for network circuits.	—
Provisioning	Provisions security, alarm profiles, MS-SPRings and overhead circuits.	Security, Alarm Profiles, MS-SPRing, Overhead Circuits, Provisionable Patchcords (PPC)
Maintenance	Displays the type of equipment and the status of each node in the network; displays working and protect software versions; and allows software to be downloaded.	Software

8.5.2.3 DCC Links

The lines show DCC connections between the nodes. DCC connections can be green (active) or gray (fail). The lines can also be solid (circuits can be routed through this link) or dashed (circuits cannot be routed through this link).

There are four possible combinations for the appearance of DCCs: green/solid, green/dashed, gray/solid, or gray/dashed. DCC appearance corresponds to the following states: active/routable, active/nonroutable, failed/routable, or failed/nonroutable. Circuit provisioning uses active/routable links.

8.5.2.4 Link Consolidation

CTC provides the ability to consolidate the DCC, general communications channel (GCC), optical transport section (OTS), provisionable patchcord (PPC), and server trail links shown in the network view into a more streamlined view. Link consolidation allows you to condense multiple inter-nodal links into a singular link. The link consolidation sorts links by class, meaning that all DCC links are consolidated together, for example.You can access individual links within consolidated links using the right-click shortcut menu.

Each link has an associated icon (Table 8-12).

Table 8-12 Link Icons

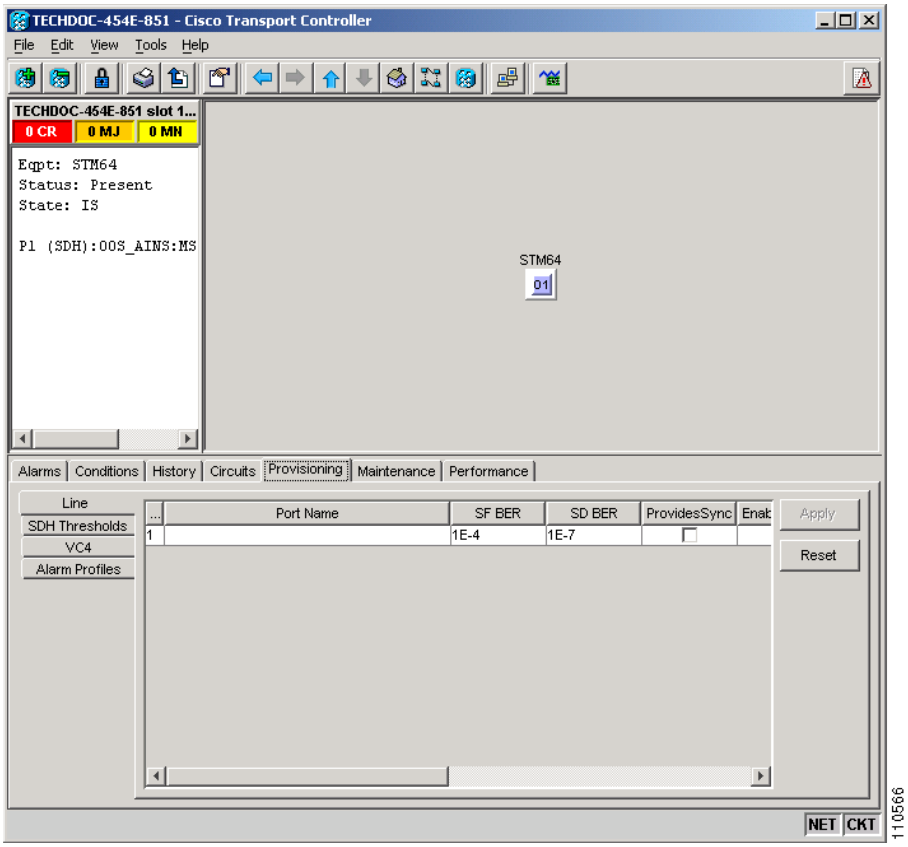
Icon	Description
	DCC icon
	GCC icon
	OTS icon
	PPC icon
	Server Trail icon

Note Link consolidation is only available on non-detailed maps. Non-detailed maps display nodes in icon form instead of detailed form, meaning the nodes appear as rectangles with ports on the sides. Refer to the *Cisco ONS 15454 SDH Procedure Guide* for more information about consolidated links.

8.5.3 Card View

Card view provides information about individual ONS 15454 SDH cards (Figure 8-7). Use this window to perform card-specific maintenance and provisioning. A graphic showing the ports on the card is shown in the graphic area. The status area displays the node name, slot, number of alarms, card type, equipment type, and the card status (active or standby), card state if the card is present, or port state (Table 8-6 on page 8-9). The information that appears and the actions you can perform depend on the card. For more information about card service states, see Appendix B, "Administrative and Service States."

Figure 8-7 CTC Card View



Note CTC provides a card view for all ONS 15454 SDH cards except the TCC2, TCC2P, XC10G, XC-VXL-10G, XC-VXL-2.5G, XC-VXC-2.5G, and SC-VSC-10G cards. Provisioning for these common control cards occurs at the node view; therefore, no card view is necessary.

Use the card view tabs and subtabs, shown in Table 8-13, to provision and manage the ONS 15454 SDH. The subtabs, fields, and information shown under each tab depend on the card type selected. The Performance tab is not available for the AIC-I card.

Table 8-13 Card View Tabs and Subtabs

Tab	Description	Subtabs
Alarms	Lists current alarms (CR, MJ, MN) for the card and updates them in real time.	—
Conditions	Displays a list of standing conditions on the card.	—
History	Provides a history of card alarms including date, object, port, and severity of each alarm.	Session (displays alarms and events for the current session), Card (displays alarms and events retrieved from a fixed-size log on the card)

Table 8-13 Card View Tabs and Subtabs (continued)

Tab	Description	Subtabs
Circuits	Creates, deletes, edits, and searches for circuits.	Circuits
Provisioning	Provisions an ONS 15454 SDH card.	DS-N and STM cards: Line, Line Thresholds (different threshold options are available for electrical and optical cards), Elect Path Thresholds, SDH Thresholds, VC4, and Alarm Profiles Ethernet cards (subtabs depend on the card type): Line, Line Thresholds, Electrical Path Thresholds, SDH Thresholds, Port, RMON Thresholds, VLAN, Card, Alarm Profiles
Maintenance	Performs maintenance tasks for the card.	Loopback, Info, Protection, and Path Trace (options depend on the card type)
Performance	Performs performance monitoring for the card.	DS-N and STM cards: no subtabs Ethernet cards: Statistics, Utilization, History
Inventory	Displays an Inventory screen of the ports (TXP and MXP cards only).	—

8.5.4 Print or Export CTC Data

You can use the File > Print or File > Export options to print or export CTC provisioning information for record keeping or troubleshooting. The functions can be performed in card, node, or network views. The File > Print function sends the data to a local or network printer. File > Export exports the data to a file where it can be imported into other computer applications, such as spreadsheets and database management programs.

Whether you choose to print or export data, you can choose from the following options:

- Entire frame—Prints or exports the entire CTC window including the graphical view of the card, node, or network. This option is available for all windows.
- Tabbed view—Prints or exports the lower half of the CTC window containing tabs and data. The printout includes the selected tab (on top) and the data shown in the tab window. For example, if you print the History window tabbed view, you print only history items appearing in the window. This option is available for all windows.
- Table Contents—Prints CTC data in table format without graphical representations of shelves, cards, or tabs. This option does not apply to all windows. For details, refer to the print or report tasks in the *Cisco ONS 15454 Procedure Guide*.

  The Table Contents option prints all the data contained in a table with the same column headings. For example, if you print the History window Table Contents view, you print all data included in the table whether or not items appear in the window.

8.6 TCC2/TCC2P Card Reset

You can reset the ONS 15454 SDH TCC2/TCC2P card by using CTC (a soft reset) or by physically reseating a TCC2/TCC2P card (a hard reset). A soft reset reboots the TCC2/TCC2P card and reloads the operating system and the application software. Additionally, a hard reset temporarily removes power from the TCC2/TCC2P card and clears all buffer memory.

You can apply a soft reset from CTC to either an active or standby TCC2/TCC2P card without affecting traffic. If you need to perform a hard reset on an active TCC2/TCC2P card, put the TCC2/TCC2P card into standby mode first by performing a soft reset.

Note When a CTC reset is performed on an active TCC2/TCC2P card, the AIC-I card goes through an initialization process and also resets because the AIC-I card is controlled by the active TCC2/TCC2P.

Note To avoid a node IP and secure IP ending up in the same domain after restoring a database, ensure that the node IP stored in the database differs in domain from that of the node in repeater mode. Also, after restoring a database, ensure that the node IP and secure IP differ in domain.

8.7 TCC2/TCC2P Card Database

When dual TCC2/TCC2P cards are installed in the ONS 15454 SDH, each TCC2/TCC2P card hosts a separate database; therefore, the protect card's database is available if the database on the working TCC2/TCC2P fails. You can also store a backup version of the database on the workstation running CTC. This operation should be part of a regular ONS 15454 SDH maintenance program at approximately weekly intervals, and should also be completed when preparing an ONS 15454 SDH for a pending natural disaster, such as a flood or fire.

Note The following parameters are not backed up and restored: node name, IP address, mask and gateway, and Internet Inter-ORB Protocol (IIOP) port. If you change the node name and then restore a backed up database with a different node name, the circuits map to the new node name. Cisco recommends keeping a record of the old and new node names.

8.8 Software Revert

When you click the Activate button after a software upgrade, the TCC2/TCC2P copies the current working database and saves it in a reserved location in the TCC2/TCC2P flash memory. If you later need to revert to the original working software load from the protect software load, the saved database installs automatically. You do not need to restore the database manually or recreate circuits.

Note The TCC2/TCC2P card does not carry any software earlier than Software R4.0. You will not be able to revert to a software release earlier than Software R4.0 with TCC2/TCC2P cards installed.

The revert feature is useful if a maintenance window closes while you are upgrading CTC software. You can revert to the protect software load without losing traffic. When the next maintenance window opens, complete the upgrade and activate the new software load.

Circuits created and provisioning done after a software load is activated (upgraded to a higher software release) will be lost with a revert. The database configuration at the time of activation is reinstated after a revert. This does not apply to maintenance reverts (for example, 4.6.2 to 4.6.1), because maintenance releases use the same database.

To perform a supported (non-service-affecting) revert from Software R7.0, the release you want to revert to must have been working at the time you first activated Software R7.0 on that node. Because a supported revert automatically restores the node configuration at the time of the previous activation, any configuration changes made after activation will be lost when you revert the software. Downloading Release 7.0 a second time after you have activated a new load ensures that no actual revert to a previous load can take place (the TCC2/TCC2P will reset, but will not be traffic affecting and will not change your database).

Security

This chapter provides information about Cisco ONS 15454 SDH user security. To provision security, refer to the *Cisco ONS 15454 SDH Procedure Guide*.

Chapter topics include:

- 9.1 User IDs and Security Levels, page 9-1
- 9.2 User Privileges and Policies, page 9-1
- 9.3 Audit Trail, page 9-7
- 9.4 RADIUS Security, page 9-8

9.1 User IDs and Security Levels

The CISCO15 user ID is provided with the ONS 15454 SDH system, but this user ID is not prompted when you sign into Cisco Transport Controller (CTC). This ID can be used to set up other ONS 15454 SDH users.

You can have up to 500 user IDs on one ONS 15454 SDH. Each CTC or Transaction Language One (TL1) user can be assigned one of the following security levels:

- Retrieve—Users can retrieve and view CTC information but cannot set or modify parameters.
- Maintenance—Users can access only the ONS 15454 SDH maintenance options.
- Provisioning—Users can access provisioning and maintenance options.
- Superuser—Users can perform all of the functions of the other security levels as well as set names, passwords, and security levels for other users.

See Table 9-3 on page 9-6 for idle user timeout information for each security level.

By default, multiple concurrent user ID sessions are permitted on the node, that is, multiple users can log into a node using the same user ID. However, you can provision the node to allow only a single login per user and prevent concurrent logins for all users.

9.2 User Privileges and Policies

This section lists user privileges for each CTC task and describes the security policies available to Superusers for provisioning.

9.2.1 User Privileges by CTC Task

Table 9-1 shows the actions that each user privilege level can perform in node view.

Table 9-1 ONS 15454 SDH Security Levels—Node View

CTC Tab	Subtab	[Subtab]:Actions	Retrieve	Maintenance	Provisioning	Superuser
Alarms	—	Synchronize/Filter/Delete Cleared Alarms	X	X	X	X
Conditions	—	Retrieve/Filter	X	X	X	X
History	Session	Filter	X	X	X	X
	Shelf	Retrieve/Filter	X	X	X	X
Circuits	Circuits	Create/Edit/Delete	—	—	X	X
		Filter/Search	X	X	X	X
	Rolls	Complete/ Force Valid Signal/ Finish	—	—	X	X
Provisioning	General	General: Edit	—	—	Partial[1]	X
		Multishelf Config: Edit	X	X	X	X
		Power Monitor: Edit	—	—	X	X
	Ether Bridge	Spanning trees: Edit	—	—	X	X
	Network	General: Edit	—	—	—	X
		General: View	X	X	X	X
		Static Routing: Create/Edit/Delete	—	—	X	X
		OSPF: Create/Edit/Delete	—	—	X	X
		RIP: Create/Edit/Delete	—	—	X	X
		Proxy: Create/Edit/Delete	—	—	—	X
		Firewall: Create/Edit/Delete	—	—	—	X
	OSI	Main Setup: Edit	—	—	—	X
		TARP: Config:Edit	—	—	—	X
		TARP: Static TDC: Add/Edit/Delete	—	—	X	X
		TARP: MAT: Add/Edit/Remove	—	—	X	X
		Routers: Setup: Edit	—	—	—	X
		Routers: Subnets: Edit/Enable/Disable	—	—	X	X
		Tunnels: Create/Edit/Delete	—	—	X	X
	MS-SPRing	Create/Edit/Delete/Upgrade	—	—	X	X
		Ring Map/Squelch Table/RIP Table	X	X	X	X
	Protection	Create/Edit/Delete	—	—	X	X

Table 9-1 ONS 15454 SDH Security Levels—Node View (continued)

CTC Tab	Subtab	[Subtab]:Actions	Retrieve	Maintenance	Provisioning	Superuser
	Security	Users: Create/Delete/Clear Security Intrusion Alarm	—	—	—	X
		Users: Edit	Same user	Same user	Same user	All users
		Active Logins: View/Logout/ Retrieve Last Activity Time	—	—	—	X
		Policy: Edit/View	—	—	—	X
		Access: Edit/View	—	—	—	X
		RADIUS Server: Create/Edit/Delete/Move Up/Move Down/View	—	—	—	X
		Legal Disclaimer: Edit	—	—	—	X
	SNMP	Create/Delete/Edit	—	—	X	X
		Browse trap destinations	X	X	X	X
	Comm Channels	RS-DCC: Create/Edit/Delete	—	—	X	X
		MS-DCC: Create/Edit/Delete	—	—	X	X
		GCC: Create/Edit/Delete	—	—	X	X
		OSC: OSC Terminations: Create/Edit/Delete	—	—	X	X
		OSC: DWDM Ring ID: Create/Edit/Delete	—	—	—	X
		PPC: Create/Edit/Delete	—	—	X	X
	Timing	General: Edit	—	—	X	X
		BITS Facilities: Edit	—	—	X	X
	Alarm Profiles	Alarm Behavior: Edit	—	—	X	X
		Alarm Profiles Editor: Store/Delete[2]	—	—	X	X
		Alarm Profile Editor: New/Load/Compare/Available/ Usage	X	X	X	X
	Cross-Connect	Edit	—	—	X	X
	Defaults	Edit/Import	—	—	—	X
		Reset/Export	X	X	X	X
	WDM-ANS	Provisioning: Edit	—	—	—	X
		Provisioning: Reset	X	X	X	X
		Internal Patchcords: Create/Edit/Delete/Commit/ Default Patchcords	—	—	X	X
		Port Status: Launch ANS	—	—	—	X
		Node Setup	X	X	X	X

Table 9-1 ONS 15454 SDH Security Levels—Node View (continued)

CTC Tab	Subtab	[Subtab]:Actions	Retrieve	Maintenance	Provisioning	Superuser
Inventory	—	Delete	—	—	X	X
		Reset	—	X	X	X
Maintenance	Database	Backup	—	X	X	X
		Restore	—	—	—	X
	EtherBridge	Spanning Trees:View	X	X	X	X
		MAC Table: Retrieve	X	X	X	X
		MAC Table: Clear/Clear All	—	X	X	X
		Trunk Utilization: Refresh	X	X	X	X
		Circuits: Refresh	X	X	X	X
	Network	Routing Table: Retrieve	X	X	X	X
		RIP Routing Table: Retrieve	X	X	X	X
	OSI	IS-IS RIB: Refresh	X	X	X	X
		ES-IS RIB: Refresh	X	X	X	X
		TDC: TID to NSAP/Flush Dynamic Entries	—	X	X	X
		TDC: Refresh	X	X	X	X
	MS-SPRing	Edit/Reset	—	X	X	X
	Protection	Switch/Lock out/Lockon/Clear/ Unlock	—	X	X	X
	Software	Download	—	X	X	X
		Activate/Revert	—	—	—	X
	Cross-Connect	Cards: Switch/Lock/Unlock	—	X	X	X
		Resource Usage: Delete	—	—	X	X
	Overhead XConnect	View	X	X	X	X
	Diagnostic	Retrieve Tech Support Log	—	—	X	X
		Lamp Test	—	X	X	X
	Timing	Source: Edit	—	X	X	X
		Report: View/Refresh	X	X	X	X
	Audit	Retrieve	—	—	—	X
		Archive	—	—	X	X
	Test Access	View	X	X	X	X
	DWDM	APC: Run/Disable/Refresh	—	X	X	X
		WDM Span Check: Edit/Retrieve Span Loss values/Reset	X	X	X	X
		ROADM Power Monitoring: Refresh	X	X	X	X

1. Provisioner user cannot change node name, contact parameters.

2. The action buttons in the subtab are active for all users, but the actions can be completely performed only by the users assigned with the required security levels.

Table 9-2 shows the actions that each user privilege level can perform in network view.

Table 9-2 ONS 15454 SDH Security Levels—Network View

CTC Tab	Subtab	[Subtab]: Actions	Retrieve	Maintenance	Provisioning	Superuser
Alarms	—	Synchronize/Filter/Delete cleared alarms	X	X	X	X
Conditions	—	Retrieve/Filter	X	X	X	X
History	—	Filter	X	X	X	X
Circuits	Circuits	Create/Edit/Delete	—	—	X	X
		Filter/Search	X	X	X	X
	Rolls	Complete, Force Valid Signal, Finish	—	—	X	X
Provisioning	Security	Users: Create/Delete	—	—	—	X
		Users: Edit	Same user	Same user	Same user	All users
		Active logins: Logout/Retrieve Last Activity Time	—	—	—	X
		Policy: Change	—	—	—	X
	Alarm Profiles	Store/Delete[1]	—	—	X	X
		New/Load/Compare/Available/ Usage	X	X	X	X
	MS-SPRing	Create/Delete/Edit/Upgrade	—	—	X	X
	Overhead Circuits	Create/Delete/Edit/Merge	—	—	X	X
		Search	X	X	X	X
	Provisionable Patchcords (PPC)	Create/ Delete	—	—	X	X
	Server Trails	Create/Edit/Delete	—	—	X	X
Maintenance	Software	Download/Cancel	—	X	X	X
	Diagnostic	OSPF Node Information: Retrieve/Clear	X	X	X	X

1. The action buttons in the subtab are active for all users, but the actions can be completely performed only by the users assigned with the required security levels.

9.2.2 Security Policies

Users with Superuser security privilege can provision security policies on the ONS 15454 SDH. These security policies include idle user timeouts, password changes, password aging, and user lockout parameters. In addition, a Superuser can prevent users from accessing the ONS 15454 SDH through the TCC2/TCC2P RJ-45 port, the MIC-C/T/P LAN connection, or both.

9.2.2.1 Superuser Privileges for Provisioning Users

Superusers can grant permission to Provisioning users to retrieve audit logs, restore databases, clear performance monitoring (PM) parameters, activate software loads, and revert software loads. These privileges can only be set using CTC network element (NE) defaults, except the PM clearing privilege, which can be granted using the CTC Provisioning > Security > Access tabs. For more information on setting up Superuser privileges, refer to the *Cisco ONS 15454 SDH Procedure Guide*.

9.2.2.2 Idle User Timeout

Each ONS 15454 SDH CTC or TL1 user can be idle during his or her login session for a specified amount of time before the CTC window is locked. The lockouts prevent unauthorized users from making changes. Higher-level users have shorter default idle periods and lower-level users have longer or unlimited default idle periods, as shown in Table 9-3. The user idle period can be modified by a Superuser; refer to the *Cisco ONS 15454 SDH Procedure Guide* for instructions.

Table 9-3 ONS 15454 SDH Default User Idle Times

Security Level	Idle Time
Superuser	15 minutes
Provisioning	30 minutes
Maintenance	60 minutes
Retrieve	Unlimited

9.2.2.3 User Password, Login, and Access Policies

Superusers can view real-time lists of users who are logged into CTC or TL1 by node. Superusers can also provision the following password, login, and node access policies.

- Password expirations and reuse—Superusers can specify when users must change and when they can reuse their passwords.
- Locking out and disabling users—Superusers can provision the number of invalid logins that are allowed before locking out users and the length of time before inactive users are disabled.
- Node access and user sessions—Superusers can limit the number of CTC sessions one user can have, and they can prohibit access to the ONS 15454 SDH using the LAN or MIC-C/T/P connections.

  In addition, a Superuser can select secure shell (SSH) instead of Telnet at the CTC Provisioning > Security > Access tabs. SSH is a terminal-remote host Internet protocol that uses encrypted links. It provides authentication and secure communication over unsecure channels. Port 22 is the default port and cannot be changed.

Note The superuser cannot modify the privilege level of an active user. The CTC displays a warning message when the superuser attempts to modify the privilege level of an active user.

9.2.2.4 Secure Access

Secure access is based on SSH and SSL protocols. Secure access can be enabled for EMS (applicable to CTC). When access is set to secure, CTC provides enhanced SFTP and SSH security when communicating with the node.

For more information on how to enable EMS secure access, refer *Cisco ONS 15454 SDH Procedure Guide* for instructions.

9.3 Audit Trail

The ONS 15454 SDH maintains an audit trail log that resides on the TCC2/TCC2P. This record shows who has accessed the system and what operations were performed during a given time period. The log includes authorized Cisco logins and logouts using the operating system command line interface, Cisco Transport Controller (CTC), and TL1; the log also includes FTP actions, circuit creation/deletion, and user/system generated actions.

Event monitoring is also recorded in the audit log. An event is defined as the change in status of an element within the network. External events, internal events, attribute changes, and software upload/download activities are recorded in the audit trail.

Audit trails are useful for maintaining security, recovering lost transactions and enforcing accountability. Accountability is the ability to trace user activities by associating a process or action with a specific user. To view the audit trail log, refer to the *Cisco ONS 15454 SDH Procedure Guide*. to view the audit trail record. Any management interface (CTC, CTM, TL1) can access the audit trail logs.

The audit trail is stored in persistent memory and is not corrupted by processor switches, resets or upgrades. However, if the TCC2/TCC2Ps are removed, the audit trail log is lost.

9.3.1 Audit Trail Log Entries

Table 9-4 contains the columns listed in Audit Trail window.

Table 9-4 Audit Trail Window Columns

Heading	Explanation
Date	Date when the action occurred
Num	Incrementing count of actions
User	User ID that initiated the action
P/F	Pass/Fail (whether or not the action was executed)
Operation	Action that was taken

Audit trail records capture the following activities:

- User—Name of the user performing the action
- Host—Host from where the activity is logged
- Device ID—IP address of the device involved in the activity
- Application—Name of the application involved in the activity
- Task—Name of the task involved in the activity (View a dialog, apply configuration and so on)
- Connection Mode—Telnet, Console, SNMP
- Category—Type of change; Hardware, Software, Configuration
- Status—Status of the user action (Read, Initial, Successful, Timeout, Failed)
- Time—Time of change

- Message Type—Denotes if the event is Success/Failure type
- Message Details—A description of the change

9.3.2 Audit Trail Capacities

The system is able to store 640 log entries.When this limit is reached, the oldest entries are overwritten with new events.

When the log server is 80 percent full, an AUD-LOG-LOW condition is raised and logged (by way of CORBA/CTC).

When the log server reaches a maximum capacity of 640 entries and begins overwriting records that were not archived, an AUD-LOG-LOSS condition is raised and logged. This event indicates that audit trail records have been lost. Until the user off-loads the file, this event occurs once regardless of the amount of entries that are overwritten by the system. To export the audit trail log, refer to the *Cisco ONS 15454 SDH Procedure Guide*.

9.4 RADIUS Security

Users with Superuser security privileges can configure nodes to use Remote Authentication Dial In User Service (RADIUS) authentication. Cisco Systems uses a strategy known as authentication, authorization, and accounting (AAA) for verifying the identity of, granting access to, and tracking the actions of remote users.

9.4.1 RADIUS Authentication

RADIUS is a system of distributed security that secures remote access to networks and network services against unauthorized access. RADIUS comprises three components:

- A protocol with a frame format that utilizes User Datagram Protocol (UDP)/IP
- A server
- A client

The server runs on a central computer typically at the customer's site, while the clients reside in the dial-up access servers and can be distributed throughout the network.

An ONS 15454 SDH node operates as a client of RADIUS. The client is responsible for passing user information to designated RADIUS servers, and then acting on the response that is returned. RADIUS servers are responsible for receiving user connection requests, authenticating the user, and returning all configuration information necessary for the client to deliver service to the user. The RADIUS servers can act as proxy clients to other kinds of authentication servers. Transactions between the client and RADIUS server are authenticated through the use of a shared secret, which is never sent over the network. In addition, any user passwords are sent encrypted between the client and RADIUS server. This eliminates the possibility that someone snooping on an unsecured network could determine a user's password. Refer to the *Cisco ONS 15454 SDH Procedure Guide* for detailed instructions for implementing RADIUS authentication.

9.4.2 Shared Secrets

A shared secret is a text string that serves as a password between:

- A RADIUS client and RADIUS server
- A RADIUS client and a RADIUS proxy
- A RADIUS proxy and a RADIUS server

For a configuration that uses a RADIUS client, a RADIUS proxy, and a RADIUS server, the shared secret that is used between the RADIUS client and the RADIUS proxy can be different than the shared secret used between the RADIUS proxy and the RADIUS server.

Shared secrets are used to verify that RADIUS messages, with the exception of the Access-Request message, are sent by a RADIUS-enabled device that is configured with the same shared secret. Shared secrets also verify that the RADIUS message has not been modified in transit (message integrity). The shared secret is also used to encrypt some RADIUS attributes, such as User-Password and Tunnel-Password.

When creating and using a shared secret:

- Use the same case-sensitive shared secret on both RADIUS devices.
- Use a different shared secret for each RADIUS server-RADIUS client pair.
- To ensure a random shared secret, generate a random sequence at least 22 characters long.
- You can use any standard alphanumeric and special characters.
- You can use a shared secret of up to 128 characters in length. To protect your server and your RADIUS clients from brute force attacks, use long shared secrets (more than 22 characters).
- Make the shared secret a random sequence of letters, numbers, and punctuation and change it often to protect your server and your RADIUS clients from dictionary attacks. Shared secrets should contain characters from each of the three groups listed in Table 9-5.

Table 9-5 Shared Secret Character Groups

Group	Examples
Letters (uppercase and lowercase)	A, B, C, D and a, b, c, d
Numerals	0, 1, 2, 3
Symbols (all characters not defined as letters or numerals)	Exclamation point (!), asterisk (*), colon (:)

The stronger your shared secret, the more secure are the attributes (for example, those used for passwords and encryption keys) that are encrypted with it. An example of a strong shared secret is 8d#>9fq4bV)H7%a3-zE13sW$hIa32M#m<PqAa72(.

CHAPTER 10

Timing

This chapter provides information about Cisco ONS 15454 SDH users and SDH timing. To provision security and timing, refer to the *Cisco ONS 15454 SDH Procedure Guide*.

Chapter topics include:

- 10.1 Timing Parameters, page 10-1
- 10.2 Network Timing, page 10-2
- 10.3 Synchronization Status Messaging, page 10-3

10.1 Timing Parameters

SDH timing parameters must be set for each ONS 15454 SDH. Each ONS 15454 SDH independently accepts its timing reference from one of three sources:

- The building integrated timing supply (BITS) pins on the MIC-C/T/P coaxial connectors.

Note For more information on BITS timing, see the "2.3.1 TCC2P Functionality" section on page 2-10.

- An STM-N card installed in the ONS 15454 SDH. The card is connected to a node that receives timing through a BITS source.
- The internal ST3 clock on the TCC2/TCC2P card.

You can set ONS 15454 SDH timing to one of three modes: external, line, or mixed. If timing is coming from the BITS pins, set the ONS 15454 SDH timing to external. If the timing comes from an STM-N card, set the timing to line. In typical ONS 15454 SDH networks:

- One node is set to external. The external node derives its timing from a BITS source wired to the BITS MIC-C/T/P coaxial connectors. The BITS source, in turn, derives its timing from a primary reference source (PRS) such as a Stratum 1 clock or global positioning satellite (GPS) signal.
- The other nodes are set to line. The line nodes derive timing from the externally timed node through the STM-N trunk (span) cards. The MSTP normally derives timing from the line using an OSCM or OSC-CSM card located inside an STM-1 channel.

You can set three timing references for each ONS 15454 SDH. The first two references are typically two BITS-level sources, or two line-level sources optically connected to a node with a BITS source. The third reference is usually assigned to the internal clock provided on every ONS 15454 SDH TCC2/TCC2P

card. However, if you assign all three references to other timing sources, the internal clock is always available as a backup timing reference. The internal clock is a Stratum 3 (ST3), so if an ONS 15454 SDH node becomes isolated, timing is maintained at the ST3 level.

The CTC Maintenance > Timing > Report tabs show current timing information for an ONS 15454 SDH, including the timing mode, clock state and status, switch type, and reference data.

Caution Mixed timing allows you to select both external and line timing sources. However, Cisco does not recommend its use because it can create timing loops. Use this mode with caution.

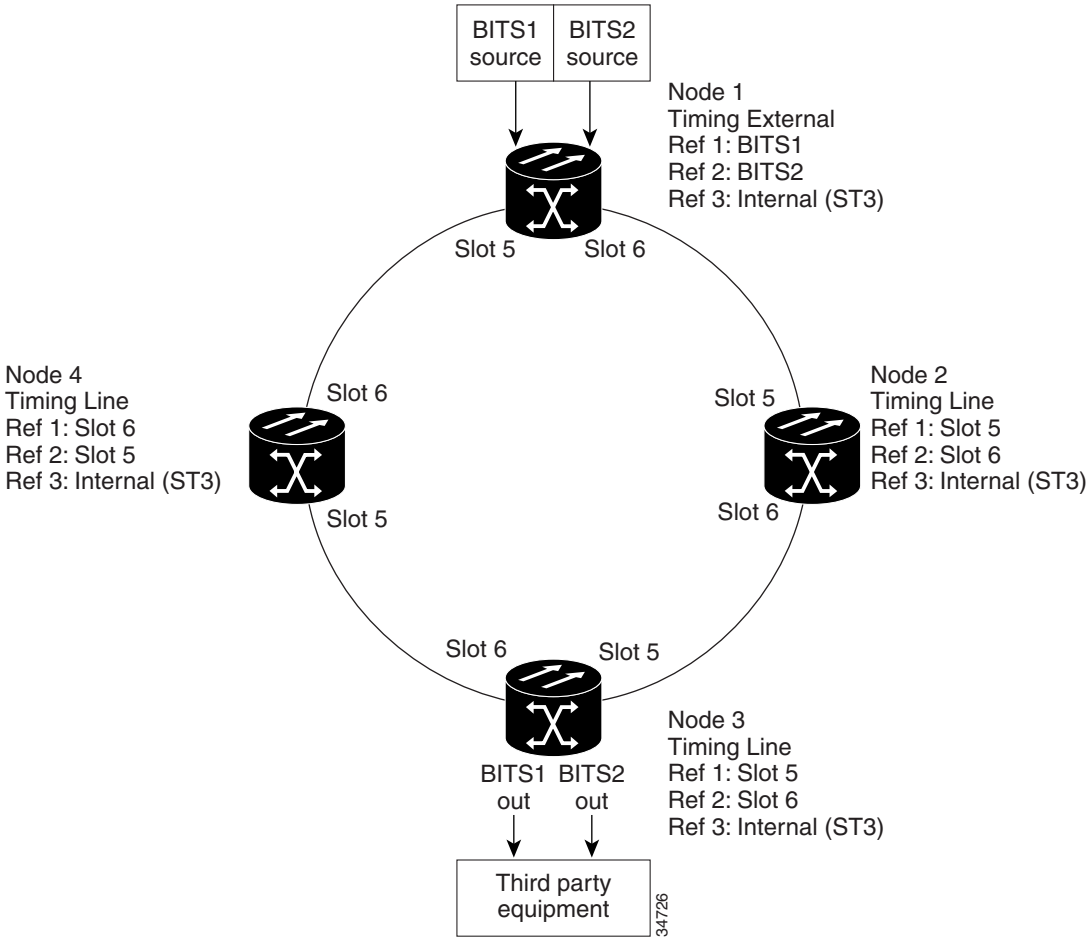
Note Only one port can be used for timing related provisioning per line card on the Cisco ONS 15454 SDH platform.

10.2 Network Timing

Figure 10-1 shows an ONS 15454 SDH network timing setup example. Node 1 is set to external timing. Two timing references are set to BITS. These are Stratum 1 timing sources wired to the BITS MIC-C/T/P coaxial connectors on Node 1. The third reference is set to internal clock. The BITS outputs on Node 3 provide timing to outside equipment, such as a digital access line access multiplexer.

In the example, Slots 5 and 6 contain the trunk (span) cards. Timing at Nodes 2, 3, and 4 is set to line, and the timing references are set to the trunk cards based on distance from the BITS source. Reference 1 is set to the trunk card closest to the BITS source. At Node 2, Reference 1 is Slot 5 because it is connected to Node 1. At Node 4, Reference 1 is set to Slot 6 because it is connected to Node 1. At Node 3, Reference 1 could be either trunk card because they are an equal distance from Node 1.

Figure 10-1 ONS 15454 SDH Timing Example



10.3 Synchronization Status Messaging

Synchronization status messaging (SSM) is an SDH protocol that communicates information about the quality of the timing source. SSM messages are carried on the S1 byte of the SDH section overhead. They enable SDH devices to automatically select the highest quality timing reference and to avoid timing loops.

SSM messages are either Generation 1 or Generation 2. Generation 1 is the first and most widely deployed SSM message set. Generation 2 is a newer version. If you enable SSM for the ONS 15454 SDH, consult your timing reference documentation to determine which message set to use. Table 10-1 shows the SDH message set.

Table 10-1 SDH SSM Message Set

Message	Quality	Description
G811	1	Primary reference clock
STU	2	Sync traceability unknown

Table 10-1 SDH SSM Message Set (continued)

Message	Quality	Description
G812T	3	Transit node clock traceable
G812L	4	Local node clock traceable
SETS	5	Synchronous equipment
DUS	6	Do not use for timing synchronization

CHAPTER 11

Circuits and Tunnels

Note The terms "Unidirectional Path Switched Ring" and "UPSR" may appear in Cisco literature. These terms do not refer to using Cisco ONS 15xxx products in a unidirectional path switched ring configuration. Rather, these terms, as well as "Path Protected Mesh Network" and "PPMN," refer generally to Cisco's path protection feature, which may be used in any topological network configuration. Cisco does not recommend using its path protection feature in any particular topological network configuration.

This chapter explains Cisco ONS 15454 SDH high-order and low-order circuits; low-order, data communication channel (DCC), and IP-encapsulated tunnels; and virtual concatenated (VCAT) circuits. To provision circuits and tunnels, refer to the *Cisco ONS 15454 SDH Procedure Guide*.

Chapter topics include:

- 11.1 Overview, page 11-2
- 11.2 Circuit Properties, page 11-2
- 11.3 Cross-Connect Card Bandwidth, page 11-11
- 11.4 DCC Tunnels, page 11-12
- 11.5 Multiple Destinations for Unidirectional Circuits, page 11-14
- 11.6 Monitor Circuits, page 11-14
- 11.7 SNCP Circuits, page 11-14
- 11.8 MS-SPRing Protection Channel Access Circuits, page 11-16
- 11.9 MS-SPRing VC4 Squelch Table, page 11-17
- 11.10 Section and Path Trace, page 11-17
- 11.11 Path Signal Label, C2 Byte, page 11-18
- 11.12 Automatic Circuit Routing, page 11-19
- 11.13 Manual Circuit Routing, page 11-20
- 11.14 Constraint-Based Circuit Routing, page 11-24
- 11.15 Virtual Concatenated Circuits, page 11-25
- 11.16 Bridge and Roll, page 11-28
- 11.17 Merged Circuits, page 11-33
- 11.18 Reconfigured Circuits, page 11-34
- 11.19 Server Trails, page 11-34

11.1 Overview

You can create circuits across and within ONS 15454 SDH nodes and assign different attributes to circuits. For example, you can:

- Create one-way, two-way (bidirectional), or broadcast circuits. VC low-order path tunnels (VC_LO_PATH_TUNNEL) are automatically set to bidirectional and do not use multiple drops.
- Assign user-defined names to circuits.
- Assign different circuit sizes.
- Enable port grouping on low-order path tunnels. Three ports form a port group. For example, in one E3-12 or one DS3i-N-12 card, four port groups are available: Ports 1 to 3 = PG1, Ports 4 to 6 = PG2, Ports 7 to 9 = PG3, and Ports 10 to 12 = PG4.

Note Monitor circuits cannot be created on a VC3 circuit in a port group.

- Automatically or manually route VC high-order and low-order path circuits.
- Automatically route VC low-order path tunnels.
- Automatically create multiple circuits with autoranging. VC low-order path tunnels do not use autoranging.
- Provide full protection to the circuit path.
- Provide only protected sources and destinations for circuits.
- Define a secondary circuit source or destination that allows you to interoperate an ONS 15454 SDH subnetwork connection protection (SNCP) ring with third-party equipment SNCPs.

You can provision circuits at any of the following points:

- Before cards are installed. The ONS 15454 SDH allows you to provision slots and circuits before installing the traffic cards. However, circuits cannot carry traffic until you install the cards and place their ports in service. For card installation procedures and ring-related procedures, refer to the *Cisco ONS 15454 SDH Procedure Guide.*
- After cards are installed, but before their ports are in service (enabled). You must put the ports in service before circuits can carry traffic.
- After you preprovision the small form-factor pluggables (SFPs) (also called pluggable port modules [PPMs]).
- When cards and SFPs are installed and ports are enabled. Circuits do not actually carry traffic until the cards and SFPs are installed and the ports are in the Unlocked-enabled state; the Locked-enabled,maintenance state; or the Unlocked-disabled,automaticInService state. Circuits carry traffic as soon as the signal is received.

11.2 Circuit Properties

The ONS 15454 SDH Circuits window, which appears in network, node, and card view, is where you can view information about circuits. The Circuits window (Figure 11-1 on page 11-4) provides the following information:

- Name—The name of the circuit. The circuit name can be manually assigned or automatically generated.

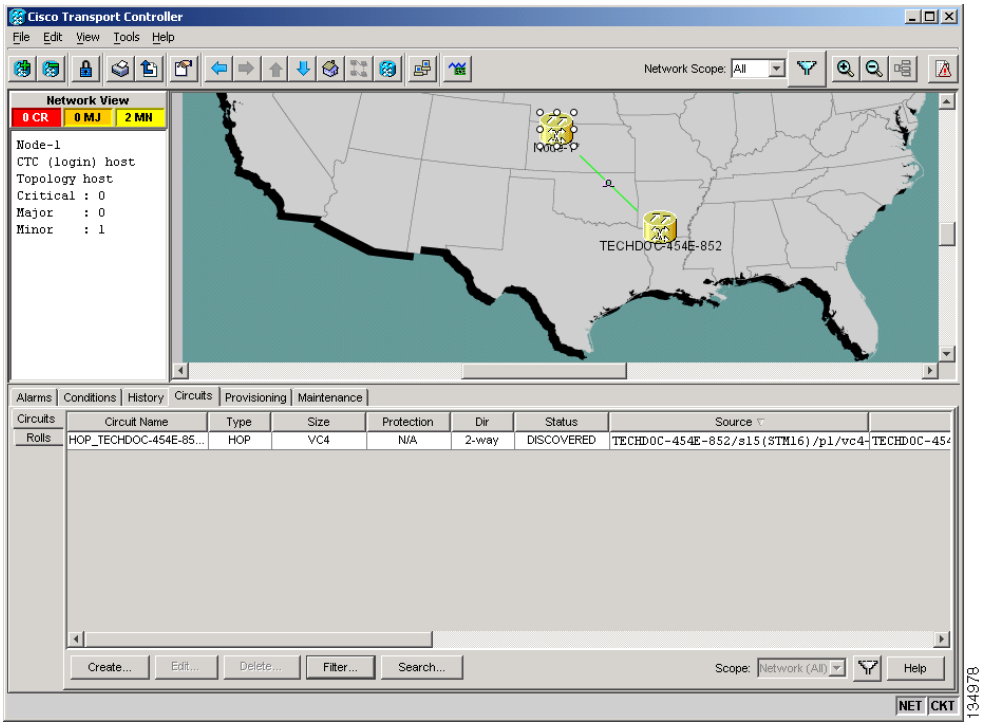
- Type—Circuit types are HOP (high-order circuit), LOP (low-order circuit), VCT (VC low-order tunnel), VCA (VC low-order aggregation point), OCHNC (dense wavelength division multiplexing [DWDM] optical channel network connection, HOP_v (high-order virtual concatenated [VCAT] circuit), and LOP_v (low-order VCAT circuit).

Note For OCHNC information, refer to the *Cisco ONS 15454 DWDM Procedure Guide*.

- Size—The circuit size. Low-order circuits are VC12, VC11 (XC-VXC-10G card only), and VC3. High-order circuit sizes are VC4, VC4-2c, VC4-3c, VC4-4c, VC4-6c, VC4-8c, VC4-12c, VC4-16c, and VC4-64c. OCHNC sizes are Equipped not specific, Multi-rate, 2.5 Gbps No FEC (forward error correction), 2.5 Gbps FEC, 10 Gbps No FEC, and 10 Gbps FEC. High-order VCAT circuits are VC4 and VC4-4c. OCHNCs are DWDM only, refer to the *Cisco ONS 15454 DWDM Procedure Guide* for more information. Low-order VCAT circuits are VC3 and VC12. For information on the number of supported members for each card, see Table 11-13 on page 11-27.
- OCHNC Wlen—For OCHNCs, the wavelength provisioned for the DWDM optical channel network connection. (DWDM only; refer to the *Cisco ONS 15454 DWDM Procedure Guide* for more information).
- Direction—The circuit direction, either two-way (bidirectional) or one-way.
- OCHNC Dir—For OCHNCs, the direction of the DWDM optical channel network connection, either east to west or west to east. (DWDM only; refer to the *Cisco ONS 15454 DWDM Procedure Guide* for more information).
- Protection—The type of circuit protection. See the "11.2.4 Circuit Protection Types" section on page 11-8.
- Status—The circuit status. See the "11.2.2 Circuit Status" section on page 11-6.
- Source—The circuit source in the format: *node/slot/port "port name"/virtual container/tributary unit group/tributary unit group/virtual container*. (The port name appears in quotes.) Node and slot always display; *port "port name"/virtual container/tributary unit group/tributary unit group/virtual container* might display, depending on the source card, circuit type, and whether a name is assigned to the port. For the STM64-XFP and MRC-12 cards, the port appears as *port pluggable module (PPM)-port*. If the circuit size is a concatenated size (VC4-2c, VC4-4c, VC4-8c, etc.), VCs used in the circuit are indicated by an ellipsis, for example, VC4-7..9 (VCs 7, 8, and 9) or VC4-10..12 (VC 10, 11, and 12).
- Destination—The circuit destination in same format (*node/slot/port "port name"/virtual container/tributary unit group/tributary unit group/virtual container*) as the circuit source.
- # of VLANS—The number of VLANs used by an Ethernet circuit with end points on E-Series Ethernet cards in single-card or multicard mode.
- # of Spans—The number of internode links that constitute the circuit. Right-clicking the column shows a shortcut menu from which you can choose Span Details to show or hide circuit span detail. For each node in the span, the span detail shows the *node/slot/port/virtual container/tributary unit group/tributary unit group/virtual container*.
- State—The circuit state. See the "11.2.3 Circuit States" section on page 11-7.

The Filter button allows you to filter the circuits in network, node, or card view based on circuit name, size, type, direction, and other attributes. In addition, you can export the Circuit window data in HTML, comma-separated values (CSV), or tab-separated values (TSV) format using the Export command from the File menu.

Figure 11-1 ONS 15454 SDH Circuit Window in Network View



11.2.1 Concatenated VC4 Time Slot Assignments

Table 11-1 shows the available time slot assignments for concatenated VC4s when using CTC to provision circuits.

Table 11-1 VC4 Mapping Using CTC

Starting VC4	VC4	VC4-2c	VC4-3c	VC4-4c	VC4-6c	VC4-8c	VC4-12c	VC4-16c	VC4-64c
1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No
3	Yes	Yes	No	No	Yes	Yes	Yes	No	No
4	Yes	No	Yes	No	Yes	Yes	Yes	No	No
5	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
6	Yes	Yes	Yes	No	Yes	Yes	No	No	No
7	Yes	Yes	Yes	No	Yes	Yes	No	No	No
8	Yes	No	No	No	Yes	Yes	No	No	No
9	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
10	Yes	Yes	Yes	No	Yes	No	No	No	No
11	Yes	Yes	No	No	Yes	No	No	No	No
12	Yes	No	No	No	No	No	No	No	No

Table 11-1 VC4 Mapping Using CTC (continued)

Starting VC4	VC4	VC4-2c	VC4-3c	VC4-4c	VC4-6c	VC4-8c	VC4-12c	VC4-16c	VC4-64c
13	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
14	Yes	Yes	Yes	No	No	No	No	No	No
15	Yes	Yes	No	No	No	No	No	No	No
16	Yes	No	Yes	No	No	No	No	No	No
17	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
18	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No
19	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No
20	Yes	No	No	No	Yes	Yes	Yes	No	No
21	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
22	Yes	Yes	Yes	No	Yes	Yes	No	No	No
23	Yes	Yes	No	No	Yes	Yes	No	No	No
24	Yes	No	No	No	Yes	Yes	No	No	No
25	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
26	Yes	Yes	Yes	No	Yes	No	No	No	No
27	Yes	Yes	No	No	Yes	No	No	No	No
28	Yes	No	Yes	No	No	No	No	No	No
29	Yes	Yes	Yes	Yes	No	No	No	No	No
30	Yes	Yes	Yes	No	No	No	No	No	No
31	Yes	Yes	Yes	No	Yes	No	No	No	No
32	Yes	No	No	No	No	No	No	No	No
33	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
34	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No
35	Yes	Yes	No	No	Yes	Yes	Yes	No	No
36	Yes	No	No	No	Yes	Yes	Yes	No	No
37	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
38	Yes	Yes	Yes	No	Yes	Yes	No	No	No
39	Yes	Yes	No	No	Yes	Yes	No	No	No
40	Yes	No	Yes	No	Yes	Yes	No	No	No
41	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
42	Yes	Yes	Yes	No	Yes	No	No	No	No
43	Yes	Yes	Yes	No	Yes	No	No	No	No
44	Yes	No	No	No	No	No	No	No	No
45	Yes	Yes	Yes	Yes	No	No	No	No	No
46	Yes	Yes	Yes	No	No	No	No	No	No
47	Yes	Yes	No	No	No	No	No	No	No

Table 11-1 VC4 Mapping Using CTC (continued)

Starting VC4	VC4	VC4-2c	VC4-3c	VC4-4c	VC4-6c	VC4-8c	VC4-12c	VC4-16c	VC4-64c
48	Yes	No	No	No	No	No	No	No	No
49	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
50	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No
51	Yes	Yes	No	No	Yes	Yes	Yes	No	No
52	Yes	No	Yes	No	Yes	Yes	Yes	No	No
53	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
54	Yes	Yes	Yes	No	Yes	Yes	No	No	No
55	Yes	Yes	Yes	No	Yes	Yes	No	No	No
56	Yes	No	No	No	Yes	Yes	No	No	No
57	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
58	Yes	Yes	Yes	No	Yes	No	No	No	No
59	Yes	Yes	No	No	Yes	No	No	No	No
60	Yes	No	No	No	No	No	No	No	No
61	Yes	Yes	Yes	Yes	Yes	No	No	No	No
62	Yes	Yes	Yes	No	Yes	No	No	No	No
63	Yes	Yes	No	No	Yes	No	No	No	No
64	Yes	No	No	No	Yes	No	No	No	No

11.2.2 Circuit Status

The circuit statuses that appear in the Circuit window Status column are generated by CTC based on conditions along the circuit path. Table 11-2 shows the statuses that can appear in the Status column.

Table 11-2 ONS 15454 SDH Circuit Status

Status	Definition/Activity
CREATING	CTC is creating a circuit.
DISCOVERED	CTC created a circuit. All components are in place and a complete path exists from circuit source to destination.
DELETING	CTC is deleting a circuit.

Table 11-2 ONS 15454 SDH Circuit Status (continued)

Status	Definition/Activity
PARTIAL	A CTC-created circuit is missing a cross-connect or network span, a complete path from source to destination(s) does not exist, or an alarm interface panel (AIP) change occurred on one of the circuit nodes and the circuit is in need of repair. (AIPs store the node MAC address.) In CTC, circuits are represented using cross-connects and network spans. If a network span is missing from a circuit, the circuit status is PARTIAL. However, a PARTIAL status does not necessarily mean a circuit traffic failure has occurred, because traffic might flow on a protect path. Network spans are in one of two states: up or down. On CTC circuit and network maps, up spans appear as green lines, and down spans appear as gray lines. If a failure occurs on a network span during a CTC session, the span remains on the network map but its color changes to gray to indicate that the span is down. If you restart your CTC session while the failure is active, the new CTC session cannot discover the span and its span line does not appear on the network map. Subsequently, circuits routed on a network span that goes down appear as DISCOVERED during the current CTC session, but appear as PARTIAL to users who log in after the span failure.
DISCOVERED_TL1	A TL1-created circuit or a TL1-like, CTC-created circuit is complete. A complete path from source to destination(s) exists.
PARTIAL_TL1	A TL1-created circuit or a TL1-like, CTC-created circuit is missing a cross-connect or circuit span (network link), and a complete path from source to destination does not exist.
CONVERSION_PENDING	An existing circuit in a topology upgrade is set to this status. The circuit returns to the DISCOVERED status when the in-service topology upgrade is complete. For more information about in-service topology upgrades, see Chapter 12, “SDH Topologies and Upgrades.”
PENDING_MERGE	Any new circuits created to represent an alternate path in a topology upgrade are set to this status to indicate that it is a temporary circuit. These circuits can be deleted if an in-service topology upgrade fails. For more information about in-service topology upgrades, see Chapter 12, “SDH Topologies and Upgrades.”
DROP_PENDING	A circuit is set to this status when a new circuit drop is being added.

11.2.3 Circuit States

The circuit service state is an aggregate of the cross-connect states within the circuit.

- If all cross-connects in a circuit are in the Unlocked-enabled service state, the circuit service state is Unlocked.
- If all cross-connects in a circuit are in a Locked state (such as Locked-enabled,maintenance; Unlocked-disabled,automaticInService; or Locked-enabled,disabled service state) or the Unlocked-disabled,automaticInService state, the circuit service state is Locked.

- Partial is appended to the Locked circuit service state when circuit cross-connects state are mixed and not all in the Unlocked-enabled service state. The Locked-partial state can occur during automatic or manual transitions between states. The Locked-partial service state can appear during a manual transition caused by an abnormal event such as a CTC crash or communication error, or if one of the cross-connects could not be changed. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for troubleshooting procedures. The Locked-partial circuit state does not apply to OCHNC circuit types.

You can assign a state to circuit cross-connects at two points:

- During circuit creation, you can set the state on the Create Circuit wizard.
- After circuit creation, you can change a circuit state in the Edit Circuit window or from the Tools > Circuits > Set Circuit State menu.

Note After you have created an initial circuit in a CTC session, the subsequent circuit states default to the circuit state of the initial circuit, regardless of which nodes in the network the circuits traverse or the node.ckt.state default setting.

During circuit creation, you can apply a service state to the drop ports in a circuit; however, CTC does not apply a requested state other than Unlocked-enabled to drop ports if:

- The port is a timing source.
- The port is provisioned for orderwire or tunnel orderwire.
- The port is provisioned as a RS-DCC, MS-DCC, or DCC tunnel.
- The port supports 1+1 or multiplex section-shared protection ring (MS-SPRing).

Circuits do not use the soak timer, but ports do. The soak period is the amount of time that the port remains in the Unlocked-disabled,automaticInService service state after a signal is continuously received. When the cross-connects in a circuit are in the Unlocked-disabled,automaticInService service state, the ONS 15454 SDH monitors the cross-connects for an error-free signal. It changes the state of the circuit from Locked to Unlocked or to Locked-partial as each cross-connect assigned to the circuit path is completed. This allows you to provision a circuit using TL1, verify its path continuity, and prepare the port to go into service when it receives an error-free signal for the time specified in the port soak timer.

To find the remaining port soak time, choose the Maintenance > AINS Soak tabs in card view and click the Retrieve button. If the port is in the Unlocked-disabled,automaticInService state and has a good signal, the Time Until IS column shows the soak count down status. If the port is Unlocked-disabled,automaticInService and has a bad signal, the Time Until IS column indicates that the signal is bad. You must click the Retrieve button to obtain the latest time value.

For more information about cross-connect states, see Appendix B, “Administrative and Service States.”

11.2.4 Circuit Protection Types

The Protection column in the Circuit window shows the card (line) and SDH topology (path) protection used for the entire circuit path. Table 11-3 shows the protection type indicators that appear in this column.

Table 11-3 Circuit Protection Types

Protection Type	Description
1+1	The circuit is protected by a 1+1 protection group.
2F MS-SPRing	The circuit is protected by a two-fiber MS-SPRing.
4F MS-SPRing	The circuit is protected by a four-fiber MS-SPRing.
2F-PCA	The circuit is routed on a protection channel access (PCA) path on a two-fiber MS-SPRing; PCA circuits are unprotected.
4F-PCA	The circuit is routed on a PCA path on a four-fiber MS-SPRing; PCA circuits are unprotected.
DRI	The circuit is protected by a dual-ring interconnection.
MS-SPRing	The circuit is protected by both a two-fiber and a four-fiber MS-SPRing.
N/A	A circuit with connections on the same node is not protected.
PCA	The circuit is routed on a PCA path on both two-fiber and four-fiber MS-SPRings; PCA circuits are unprotected.
Protected	The circuit is protected by diverse SDH topologies, for example, an MS-SPRing and an SNCP, or an SNCP and a 1+1 protection group.
SNCP	The circuit is protected by an SNCP.
SPLITTER	The circuit is protected by the protect transponder (TXPP_MR_2.5G) splitter protection. For splitter information, refer to the *Cisco ONS 15454 DWDM Installation and Operations Guide*.
Unknown	A circuit has a source and destination on different nodes and communication is down between the nodes. This protection type appears if not all circuit components are known.
Unprot (black)	A circuit with a source and destination on different nodes is not protected.
Unprot (red)	A circuit created as a fully protected circuit is no longer protected due to a system change, such as removal of a MS-SPRing or 1+1 protection group.
Y-Cable	The circuit is protected by a transponder or muxponder card Y-cable protection group. For more information, refer to the *Cisco ONS 15454 DWDM Installation and Operations Guide.*

11.2.5 Circuit Information in the Edit Circuit Window

You can edit a selected circuit using the Edit button on the Circuits window. The tabs that appear depend on the circuit chosen:

- General—Displays general circuit information and allows you to edit the circuit name.
- Drops—Allows you to add a drop to a unidirectional circuit. For more information, see the "11.5 Multiple Destinations for Unidirectional Circuits" section on page 11-14.
- Monitors—Displays possible monitor sources and allows you to create a monitor circuit. For more information, see the "11.6 Monitor Circuits" section on page 11-14.
- UPSR Selectors—Allows you to change path protection selectors. For more information, see the "11.7 SNCP Circuits" section on page 11-14.

- UPSR Switch Counts—Allows you to change path protection switch protection paths. For more information, see the "11.7 SNCP Circuits" section on page 11-14.
- State—Allows you to edit cross-connect service states.
- Merge—Allows you to merge aligned circuits. For more information, see the "11.17 Merged Circuits" section on page 11-33.

Using the Export command from the File menu, you can export data from the UPSR Selectors, UPSR Switch Counts, State, and Merge tabs in HTML, comma-separated values (CSV), or tab-separated values (TSV) format.

The Show Detailed Map checkbox in the Edit Circuit window updates the graphical view of the circuit to show more detailed routing information, such as:

- Circuit direction (unidirectional/bidirectional)
- The nodes, VC4s, VC3/TUG3, TUG2s, VC12s, and VC11s through which the circuit passes, including slots and port numbers
- The circuit source and destination points
- Open Shortest Path First (OSPF) area IDs
- Link protection (SNCP, unprotected, MS-SPRing, 1+1) and bandwidth (STM-N)

For MS-SPRings, the detailed map shows the number of MS-SPRing fibers and the MS-SPRing ring ID. For SNCP rings, the map shows the active and standby paths from circuit source to destination, and it also shows the working and protect paths. Selectors appear as pentagons on the detailed circuit map. The map indicates nodes set up as dual-ring interconnect nodes. For VCAT circuits, the detailed map is not available for an entire VCAT circuit. However, you can view the detailed map to view the circuit route for each individual member.

You can also view alarms and states on the circuit map, including:

- Alarm states of nodes on the circuit route
- Number of alarms on each node organized by severity
- Port service states on the circuit route
- Alarm state/color of the most severe alarm on the port
- Loopbacks
- Path trace states
- Path selectors states

For example, in an SNCP, the working path is indicated by a green, bidirectional arrow, and the protect path is indicated by a purple, bidirectional arrow. Source and destination ports are shown as circles with an S and a D. Port service states are indicated by colors, shown in Table 11-4.

Table 11-4 Port State Color Indicators

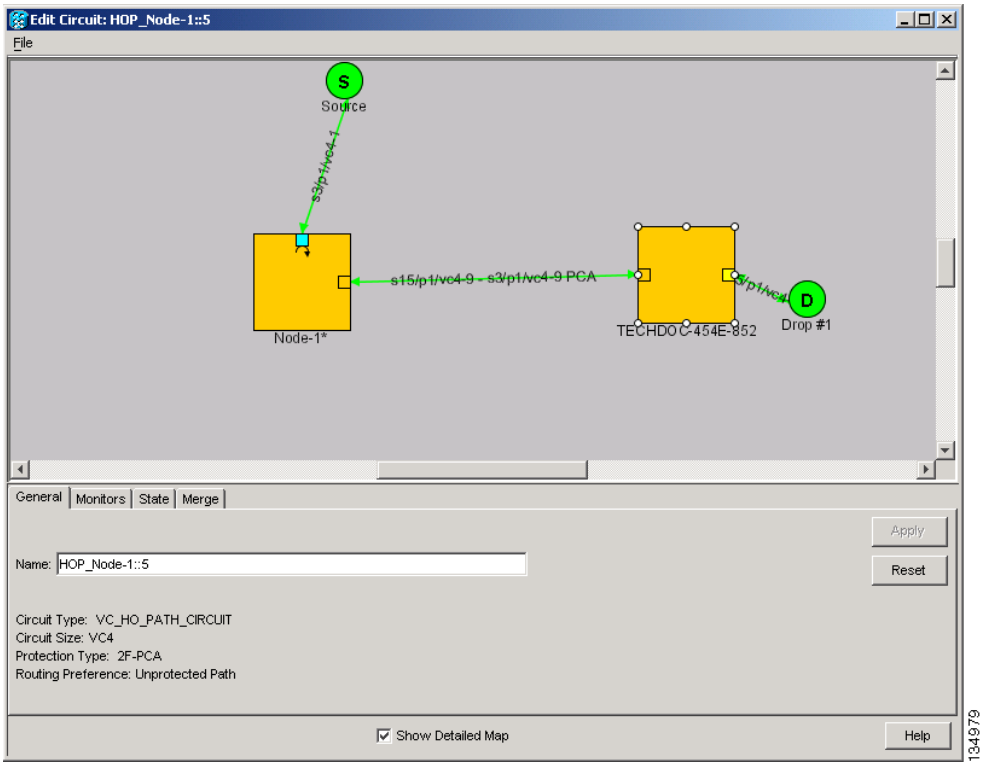
Port Color	Service State
Green	Unlocked-enabled
Gray	Locked-enabled,disabled
Violet	Unlocked-disabled,automaticInService
Blue (Cyan)	Locked-enabled,maintenance

A notation within or by the squares or selector pentagons on each node indicates switches and loopbacks, including:

- F = Force switch
- M = Manual switch
- L = Lockout switch
- Arrow = Facility (outward) or terminal (inward) loopback

Figure 11-2 shows an example of a 2F-PCA circuit with a card in terminal loopback in the Edit Circuits window.

Figure 11-2 Terminal Loopback in the Edit Circuits Window



Move the mouse cursor over nodes, ports, and spans to see tooltips with information including the number of alarms on a node (organized by severity), port service state, and the protection topology.

Right-click a node, port, or span on the detailed circuit map to initiate certain circuit actions:

- Right-click a unidirectional circuit destination node to add a drop to the circuit.
- Right-click a port containing a path trace capable card to initiate the path trace.
- Right-click an SNCP span to change the state of the path selectors in the SNCP circuit.

11.3 Cross-Connect Card Bandwidth

The XC-VXL-10G, XC-VXL-2.5G, and XC-VXC-10G cards support both low-order and high-order circuits, although only the XC-VXC-10G card supports VC-11 (low-order) circuits. The XC-VXL-10G and XC-VXL-2.5G cards manage up to 192 bidirectional STM-1 cross-connects, 192 bidirectional E-3

or DS-3 cross-connects, or 1008 bidirectional E-1 cross-connects. The XC-VXC-10G card manages up to 576 bidirectional STM-1 cross-connects, 576 bidirectional E-3 or DS-3 cross-connects, or 1344 bidirectional E-1 cross-connects.

The XC-VXL-10G, XC-VXL-2.5G, and XC-VXC-10G cards work with the TCC2/TCC2P card to maintain connections and set up cross-connects within the node. You can create circuits using CTC.

Note Chapter 2, "Common Control Cards," contains detailed specifications of the XC-VXL-10G, XC-VXL-2.5G, and XC-VXC-10G cards.

11.4 DCC Tunnels

SDH provides four DCCs for network element operation, administration, maintenance, and provisioning: one on the SDH regenerator section layer (RS-DCC) and three on the SDH multiplex section layer, also called multiplex-section DCC (MS-DCC). A regenerator-section DCC (RS-DCC) and multiplex-section DCC (MS-DCC) each provide 192 Kbps of bandwidth per channel. The aggregate bandwidth of the three RS-DCCs is 576 Kbps. When multiple DCC channels exist between two neighboring nodes, the ONS 15454 SDH balances traffic over the existing DCC channels. You can tunnel third-party SDH equipment across ONS 15454 SDH networks using one of two tunneling methods, a traditional DCC tunnel or an IP-encapsulated tunnel.

11.4.1 Traditional DCC Tunnels

In traditional DCC tunnels, the ONS 15454 SDH uses RS-DCC for inter-ONS-15454-SDH data communications. It does not use the multiplex section DCCs; therefore, the MS-DCCs are available to tunnel DCCs from third-party equipment across ONS 15454 SDH networks. If D4 through D12 are used as data DCCs, they cannot be used for DCC tunneling.

A traditional DCC tunnel endpoint is defined by slot, port, and DCC, where DCC can be either the RS-DCC, Tunnel 1, Tunnel 2, or Tunnel 3. You can link an RS-DCC to a MS-DCC (Tunnel 1, Tunnel 2, or Tunnel 3) and a MS-DCC to an RS-DCC. You can also link MS-DCCs to MS-DCCs and link RS-DCCs to RS-DCCs. To create a DCC tunnel, you connect the tunnel end points from one ONS 15454 SDH STM-N port to another. Cisco recommends a maximum of 84 DCC tunnel connections for an ONS 15454 SDH. Table 11-5 shows the DCC tunnels that you can create.

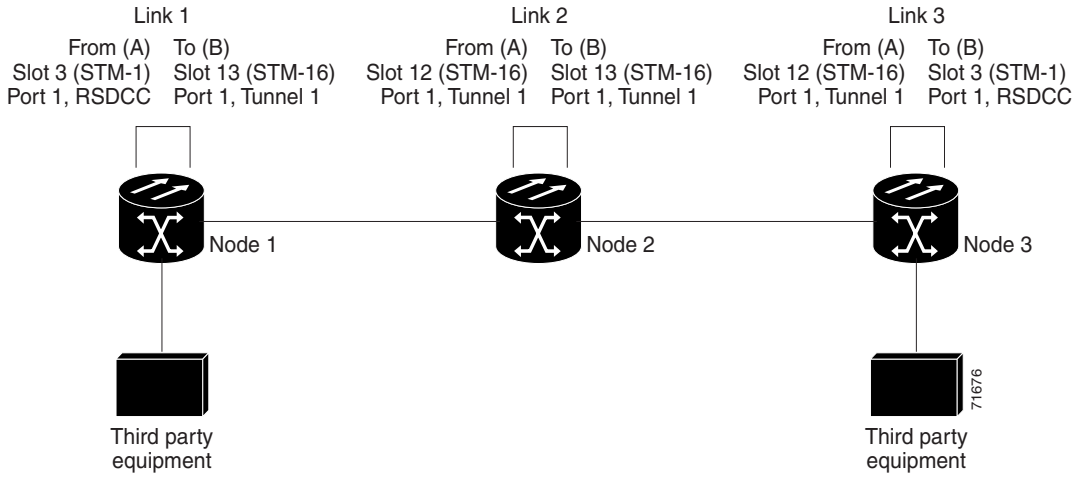
Table 11-5 DCC Tunnels

DCC	SDH Layer	SDH Bytes	STM-1 (All Ports)	STM-4, STM-16, STM-64
RS-DCC	Regenerator Section	D1 to D3	Yes	Yes
Tunnel 1	Multiplex Section	D4 to D6	No	Yes
Tunnel 2	Multiplex Section	D7 to D9	No	Yes
Tunnel 3	Multiplex Section	D10 to D12	No	Yes

Figure 11-3 shows a DCC tunnel example. Third-party equipment is connected to STM-1 cards at Node 1/Slot 3/Port 1 and Node 3/Slot 3/Port 1. Each ONS 15454 SDH node is connected by STM-16 trunk (span) cards. In the example, three tunnel connections are created, one at Node 1 (STM-1 to STM-16), one at Node 2 (STM-16 to STM-16), and one at Node 3 (STM-16 to STM-1).

Note A DCC does not function on a mixed network of ONS 15454 SDH nodes and ONS 15454 nodes. DCC tunneling is required for ONS 15454 SDH nodes transporting data through ONS 15454 nodes.

Figure 11-3 Traditional DCC Tunnel



When you create DCC tunnels, keep the following guidelines in mind:

- Each ONS 15454 SDH can have up to 84 DCC tunnel connections.
- Each ONS 15454 SDH can have up to 84 RS-DCC terminations.
- An RS-DCC that is terminated cannot be used as a DCC tunnel endpoint.
- An RS-DCC that is used as a DCC tunnel endpoint cannot be terminated.
- All DCC tunnel connections are bidirectional.

Note An MS-DCC cannot be used for tunneling if a data DCC is assigned.

11.4.2 IP-Encapsulated Tunnels

An IP-encapsulated tunnel puts an RS-DCC in an IP packet at a source node and dynamically routes the packet to a destination node. A traditional DCC tunnel is configured as one dedicated path across a network and does not provide a failure recovery mechanism if the path is down. An IP-encapsulated tunnel is a virtual path, which adds protection when traffic travels between different networks.

IP-encapsulated tunneling has the potential of flooding the DCC network with traffic resulting in a degradation of performance for CTC. The data originating from an IP tunnel can be throttled to a user-specified rate, which is a percentage of the total RS-DCC bandwidth.

Each ONS 15454 SDH supports up to ten IP-encapsulated tunnels. You can convert a traditional DCC tunnel to an IP-encapsulated tunnel or an IP-encapsulated tunnel to a traditional DCC tunnel. Only tunnels in the DISCOVERED status can be converted.

Caution Converting from one tunnel type to the other is service-affecting.

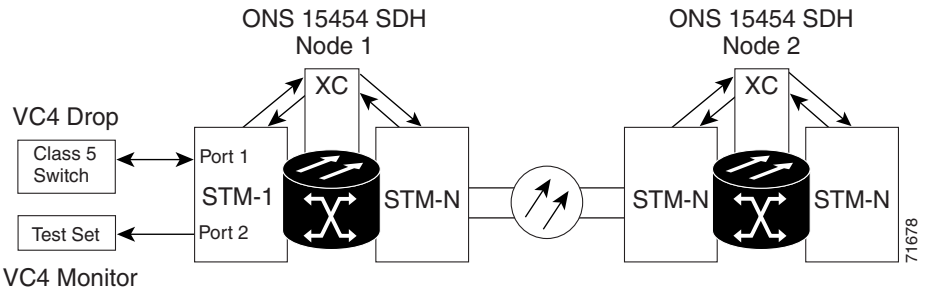
11.5 Multiple Destinations for Unidirectional Circuits

Unidirectional circuits can have multiple destinations for use in broadcast circuit schemes. In broadcast scenarios, one source transmits traffic to multiple destinations, but traffic is not returned back to the source. When you create a unidirectional circuit, the card that does have its receive (Rx) input terminated with a valid input signal generates a loss of signal (LOS) alarm. To mask the alarm, create an alarm profile suppressing the LOS alarm and apply it to the port that does not have its Rx input terminated.

11.6 Monitor Circuits

Monitor circuits are secondary circuits that monitor traffic on primary bidirectional circuits. Monitor circuits can be created on E1 or STM-N cards. Figure 11-4 shows an example of a monitor circuit. At Node 1, a VC4 is dropped from Port 1 of an STM-1 card. To monitor the VC4 traffic, test equipment is plugged into Port 2 of the STM-1 card and a monitor circuit to Port 2 is provisioned in CTC. Circuit monitors are one-way. The monitor circuit in Figure 11-4 is used to monitor VC4 traffic received by Port 1 of the STM-1 card.

Figure 11-4 VC4 Monitor Circuit Received at an STM-1 Port



Note Monitor circuits cannot be used with Ethernet circuits.

11.7 SNCP Circuits

Use the Edit Circuits window to change SNCP selectors and switch protection paths. In the SNCP Selectors subtab on the Edit Circuits window, you can:

- View the SNCP circuit's working and protection paths.
- Edit the reversion time.
- Set the hold-off timer.
- Edit the Signal Fail (SF)/Signal Degrade (SD) bit error rate (BER) thresholds.

Note The XC-VXC-10G cross-connect card supports VC switching based on SF and SD bit error rate (BER) thresholds. The XC-VXL-10G and XC-VXL-2.5G cross-connect cards do not support VC switching based on SF and SD BER thresholds, and hence, in the SNCP path protection Selectors tab, the SF BER Level and SD BER Level columns display "N/A" for these cards.

On the SNCP Switch Counts subtab, you can:

- Perform maintenance switches on the circuit selector.
- View switch counts for the selectors.

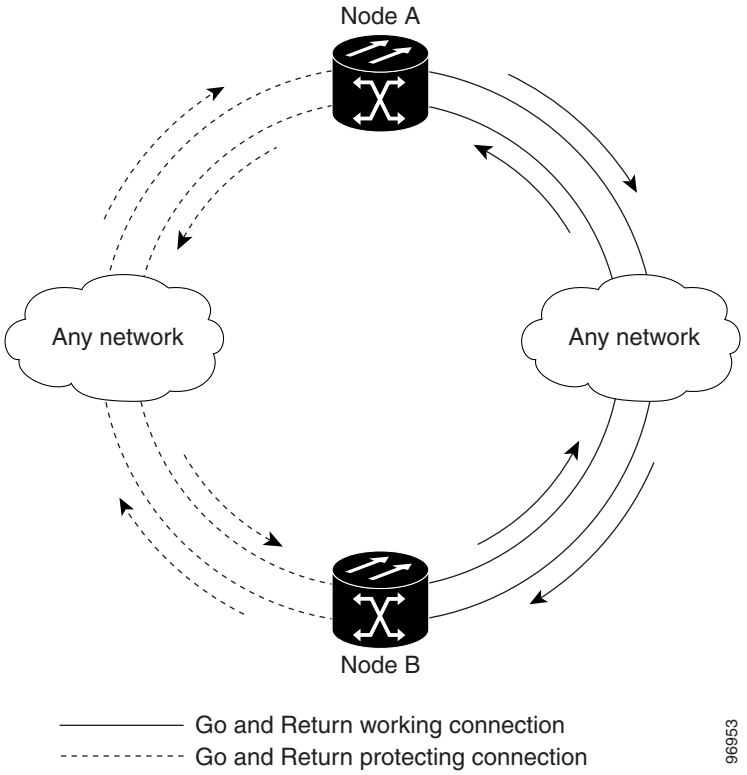
11.7.1 Open-Ended SNCP Circuits

If ONS 15454 SDH nodes are connected to a third-party network, you can create an open-ended SNCP circuit to route a circuit through it. To do this, you create three circuits. One circuit is created on the source ONS 15454 SDH network. This circuit has one source and two destinations, one at each ONS 15454 SDH that is connected to the third-party network. The second circuit is created on the third-party network so that the circuit travels across the network on two paths to the ONS 15454 SDH nodes. That circuit routes the two circuit signals across the network to ONS 15454 SDH nodes that are connected to the network on other side. At the destination node network, the third circuit is created with two sources, one at each node connected to the third-party network. A selector at the destination node chooses between the two signals that arrive at the node, similar to a regular SNCP circuit.

11.7.2 Go-and-Return SNCP Routing

The go-and-return SNCP routing option allows you to route the SNCP working path on one fiber pair and the protect path on a separate fiber pair (Figure 11-5). The working path will always be the shortest path. If a fault occurs, neither the working fibers nor the protection fibers are affected. This feature only applies to bidirectional SNCP circuits. The go-and-return option appears on the Circuit Attributes panel of the Circuit Creation wizard.

Figure 11-5 SNCP Go-and-Return Routing



11.8 MS-SPRing Protection Channel Access Circuits

You can provision circuits to carry traffic on MS-SPRing protection channels when conditions are fault free. Traffic routed on MS-SPRing PCA circuits, called extra traffic, has lower priority than the traffic on the working channels and has no means for protection. During ring or span switches, PCA circuits are preempted and squelched. For example, in a two-fiber STM-16 MS-SPRing, STMs 9 to 16 can carry extra traffic when no ring switches are active, but PCA circuits on these STMs are preempted when a ring switch occurs. When the conditions that caused the ring switch are remedied and the ring switch is removed, PCA circuits are restored if the MS-SPRing is provisioned as revertive.

Provisioning traffic on MS-SPRing protection channels is performed during circuit provisioning. The Protection Channel Access check box appears whenever Fully Protected Path is unchecked on the circuit creation wizard. Refer to the *Cisco ONS 15454 SDH Procedure Guide* for more information. When provisioning PCA circuits, two considerations are important:

- If MS-SPRings are provisioned as nonrevertive, PCA circuits are not restored automatically after a ring or span switch. You must switch the MS-SPRing manually.
- PCA circuits are routed on working channels when you upgrade a MS-SPRing from a two-fiber to a four-fiber or from one STM-N speed to a higher STM-N speed. For example, if you upgrade a two-fiber STM-16 MS-SPRing to an STM-64, STMs 9 to 16 on the STM-16 MS-SPRing become working channels on the STM-64 MS-SPRing.

11.9 MS-SPRing VC4 Squelch Table

MS-SPRing VC4 squelch tables show VC4s that will be squelched for every isolated node.

The MS-SPRing Squelch Table window displays the following information:

- VC4 Number—Shows the MS-SPRing VC4 numbers. For two-fiber MS-SPRings, the number of VC4s is half the MS-SPRing OC-N, for example, an STM-16 MS-SPRing squelch table will show 8 VC4s. For four-fiber MS-SPRings, the number of VC4s in the table is the same as the MS-SPRing STM-N.
- West Source—If traffic is received by the node on its west span, the MS-SPRing node ID of the source appears. (To view the MS-SPRing node IDs for all nodes in the ring, click the Ring Map button.)
- West Dest—If traffic is sent on the node's west span, the MS-SPRing node ID of the destination appears.
- East Source—If traffic is received by the node on its east span, the MS-SPRing node ID of the source appears.
- East Dest—If traffic is sent on the node's east span, the MS-SPRing node ID of the destination appears.

Note MS-SPRing squelching is performed on VC4s that carry VC4 circuits only.

11.10 Section and Path Trace

SDH J1 and J2 path trace are repeated, fixed-length strings composed of 64 consecutive bytes. You can use the strings to monitor interruptions or changes to circuit traffic. The STM64-XFP and MRC-12 cards support J0 section trace. Table 11-6 shows the ONS 15454 SDH cards that support J1 path trace. Cards that are not listed in the table do not support the J1 byte.

Table 11-6 ONS 15454 SDH Cards Capable of J1 Path Trace

J1 Function	Cards
Transmit and receive	E3-12
	DS3i-N-12
	G-Series
	ML-Series
Receive only	OC3 IR 4/STM1 SH 1310
	OC12/STM4-4
	OC48 IR/STM16 SH AS 1310
	OC48 LR/STM16 LH AS 1550
	OC192 LR/STM64 LH 1550

Table 11-7 shows cards that support J2 path trace.

Table 11-7 ONS 15454 SDH Cards Capable of J2 Path Trace

J2 Function	Cards
Transmit and Receive	E1-42
Receive Only	STM1E-12

If the string received at a circuit drop port does not match the string the port expects to receive, an alarm is raised. Two path trace modes are available:

- Automatic—The receiving port assumes that the first string it receives is the baseline string.
- Manual—The receiving port uses a string that you manually enter as the baseline string.

11.11 Path Signal Label, C2 Byte

One of the overhead bytes in the SDH frame is the C2 byte. The SDH standard defines the C2 byte as the path signal label. The purpose of this byte is to communicate the payload type being encapsulated by the high-order path overhead (HO-POH). The C2 byte functions similarly to EtherType and Logical Link Control (LLC)/Subnetwork Access Protocol (SNAP) header fields on an Ethernet network; it allows a single interface to transport multiple payload types simultaneously. Table 11-8 provides the C2 byte hex values.

Table 11-8 STM Path Signal Label Assignments for Signals

Hex Code	Content of the STM Synchronous Payload Envelope (SPE)
0x00	Unequipped
0x01	Equipped—nonspecific payload
0x02	Tributary unit group (TUG) structure
0x03	Locked tributary unit (TU-n)
0x04	Asynchronous mapping of 34,368 kbps or 44,736 kbps into container-3 (C-3)
0x12	Asynchronous mapping of 139,264 kbps into container-4 (C-4)
0x13	Mapping for asynchronous transfer mode (ATM)
0x14	Mapping for Distributed Queue Dual Bus (DQDB)
0x15	Asynchronous mapping for Fiber Distributed Data Interface (FDDI)
0xFE	0.181 Test signal (TSS1 to TSS3) mapping SDH network (see ITU-T G.707)
0xFF	Virtual container-alarm indication signal (VC-AIS)

If a circuit is provisioned using a terminating card, the terminating card provides the C2 byte. A low-order path circuit is terminated at the cross-connect card and the cross-connect card generates the C2 byte (0x02) downstream to the VC terminating cards. The cross-connect generates the C2 value (0x02) to the terminating card. If an STM-N circuit is created with no terminating cards, the test equipment must supply the path overhead in terminating mode. If the test equipment is in pass-through mode, the C2 values usually change rapidly between 0x00 and 0xFF. Adding a terminating card to an STM-N circuit usually fixes a circuit having C2 byte problems.

11.12 Automatic Circuit Routing

If you select automatic routing during circuit creation, CTC routes the circuit by dividing the entire circuit route into segments based on protection domains. For unprotected segments of circuits provisioned as fully protected, CTC finds an alternate route to protect the segment, creating a virtual SNCP. Each segment of a circuit path is a separate protection domain. Each protection domain is protected in a specific protection scheme including card protection (1+1, 1:1, etc.) or SDH topology (SNCP, MS-SPRing, etc.).

The following list provides principles and characteristics of automatic circuit routing:

- Circuit routing tries to use the shortest path within the user-specified or network-specified constraints. Low-order tunnels are preferable for low-order circuits because low-order tunnels are considered shortcuts when CTC calculates a circuit path in path-protected mesh networks.
- If you do not choose Fully Path Protected during circuit creation, circuits can still contain protected segments. Because circuit routing always selects the shortest path, one or more links and/or segments can have some protection. CTC does not look at link protection while computing a path for unprotected circuits.
- Circuit routing does not use links that are down. If you want all links to be considered for routing, do not create circuits when a link is down.
- Circuit routing computes the shortest path when you add a new drop to an existing circuit. It tries to find the shortest path from the new drop to any nodes on the existing circuit.
- If the network has a mixture of low-order-capable nodes and low-order-incapable nodes, CTC might automatically create a low-order tunnel. Otherwise, CTC asks you whether or not a low-order tunnel is needed.

11.12.1 Bandwidth Allocation and Routing

Within a given network, CTC routes circuits on the shortest possible path between source and destination based on the circuit attributes, such as protection and type. CTC considers using a link for the circuit only if the link meets the following requirements:

- The link has sufficient bandwidth to support the circuit.
- The link does not change the protection characteristics of the path.
- The link has the required time slots to enforce the same time slot restrictions for MS-SPRing.

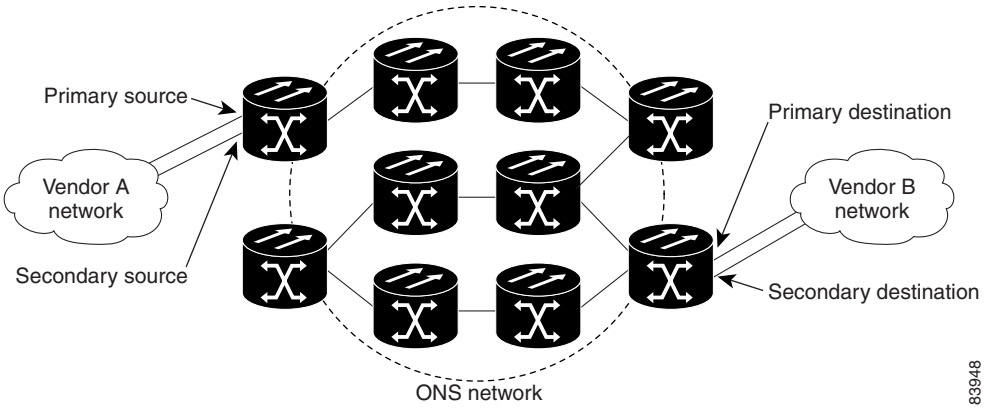
If CTC cannot find a link that meets these requirements, an error appears.

The same logic applies to low-order circuits on low-order tunnels. Circuit routing typically favors low-order tunnels because low-order tunnels are shortcuts between a given source and destination. If the low-order tunnel in the route is full (no more bandwidth), CTC asks whether you want to create an additional low-order tunnel.

11.12.2 Secondary Sources and Destinations

CTC supports secondary sources and destinations (drops). Secondary sources and destinations typically interconnect two “foreign” networks (Figure 11-6). Traffic is protected while it goes through a network of ONS 15454 SDH nodes.

Figure 11-6 Secondary Sources and Destinations



Several rules apply to secondary sources and destinations:

- CTC does not allow a secondary destination for unidirectional circuits, because you can always specify additional destinations after you create the circuit.
- Primary and secondary sources should be on the same node.
- Primary and secondary destinations should be on the same node.

Note DRI and open-ended SNCP nodes allow primary and secondary sources and destinations on different nodes.

- Secondary sources and destinations are permitted only for regular high-order or low-order connections (not for low-order tunnels and multicard EtherSwitch circuits).
- For point-to-point (straight) Ethernet circuits, only VC endpoints can be specified as multiple sources or drops.

For bidirectional circuits, CTC creates an SNCP connection at the source node that allows traffic to be selected from one of the two sources on the ONS 15454 SDH network. If you check the Fully Path Protected option during circuit creation, traffic is protected within the ONS 15454 SDH network. At the destination, another SNCP connection is created to bridge traffic from the ONS 15454 SDH network to the two destinations. A similar but opposite path exists for the reverse traffic flowing from the destinations to the sources. For unidirectional circuits, an SNCP drop-and-continue connection is created at the source node.

11.13 Manual Circuit Routing

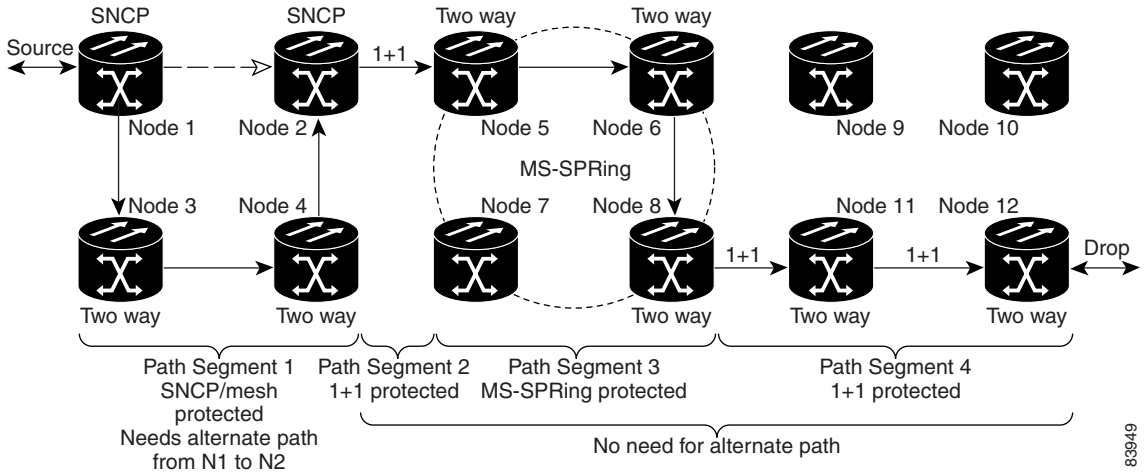
Routing circuits manually allows you to:

- Choose a specific path, not necessarily the shortest path.
- Choose a specific VC4/VC3/TUG3/TUG2/VC12/VC11 on each link along the route.
- Create a shared packet ring for multicard EtherSwitch circuits.
- Choose a protected path for multicard EtherSwitch circuits, allowing virtual SNCP segments.

CTC imposes the following rules on manual routes:

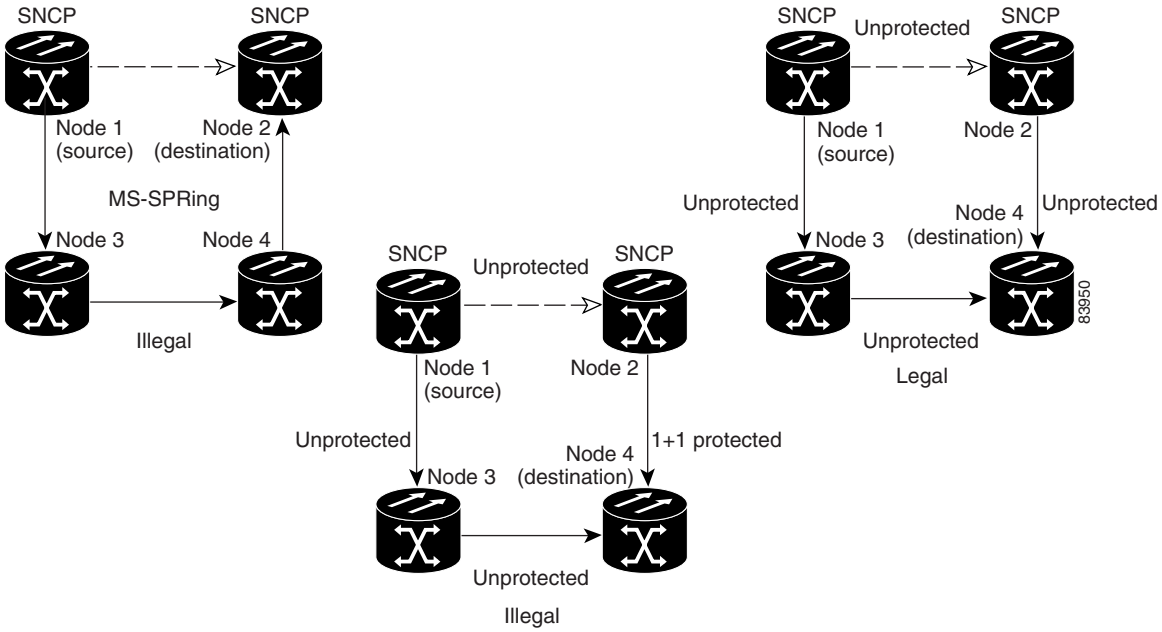
- All circuits, except multicard EtherSwitch circuits in a shared packet ring, should have links with a direction that flows from source to destination. This is true for multicard EtherSwitch circuits that are not in a shared packet ring.
- If you enabled Fully Path Protected, choose a diverse protect (alternate) path for every unprotected segment (Figure 11-7).

Figure 11-7 Alternate Paths for Virtual SNCP Segments



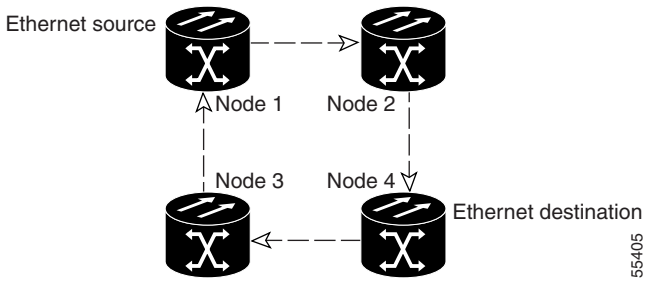
- For multicard EtherSwitch circuits, the Fully Path Protected option is ignored.
- For a node that has an SNCP selector based on the links chosen, the input links to the SNCP selectors cannot be 1+1 or MS-SPRing protected (Figure 11-8). The same rule applies at the SNCP bridge.

Figure 11-8 Mixing 1+1 or MS-SPRing Protected Links with an SNCP



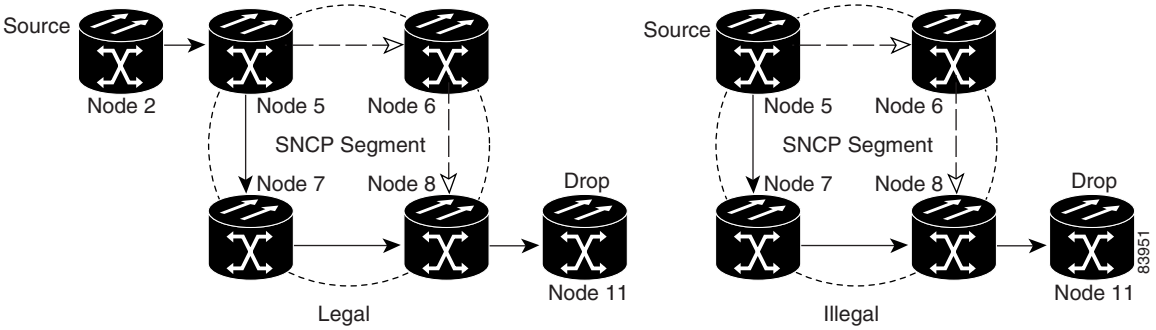
- Choose the links of multicard EtherSwitch circuits in a shared packet ring to route the circuit from source to destination back to source (Figure 11-9). Otherwise, a route (set of links) chosen with loops is invalid.

Figure 11-9 Ethernet Shared Packet Ring Routing



- Multicard EtherSwitch circuits can have virtual SNCP segments if the source or destination is not in the SNCP domain. This restriction also applies after circuit creation; therefore, if you create a circuit with SNCP segments, Ethernet drops cannot exist anywhere on the SNCP segment (Figure 11-10).

Figure 11-10 Ethernet and SNCP



- Low-order tunnels cannot be the endpoint of an SNCP segment. A SNCP segment endpoint is where the SNCP selector resides.

If you provision full path protection, CTC verifies that the route selection is protected at all segments. A route can have multiple protection domains with each domain protected by a different scheme.

Table 11-9 through Table 11-12 on page 11-23 summarize the available node connections. Any other combination is invalid and generates an error.

Table 11-9 Bidirectional VC/TUG/Regular Multicard EtherSwitch/Point-to-Point (Straight) Ethernet Circuits

Connection Type	Number of Inbound Links	Number of Outbound Links	Number of Sources	Number of Drops
SNCP	—	2	1	—
SNCP	2	—	—	1
SNCP	2	1	—	—
SNCP	1	2	—	—
SNCP	1	—	—	2

Table 11-9 Bidirectional VC/TUG/Regular Multicard EtherSwitch/Point-to-Point (Straight) Ethernet Circuits (continued)

Connection Type	Number of Inbound Links	Number of Outbound Links	Number of Sources	Number of Drops
SNCP	—	1	2	—
Double SNCP	2	2	—	—
Double SNCP	2	—	—	2
Double SNCP	—	2	2	—
Two way	1	1	—	—
Ethernet	0 or 1	0 or 1	Ethernet node source	—
Ethernet	0 or 1	0 or 1	—	Ethernet node drop

Table 11-10 Unidirectional Circuit

Connection Type	Number of Inbound Links	Number of Outbound Links	Number of Sources	Number of Drops
One way	1	1	—	—
SNCP headend	1	2	—	—
SNCP headend	—	2	1	—
SNCP drop and continue	2	—	—	1+

Table 11-11 Multicard Group Ethernet Shared Packet Ring Circuit

Connection Type	Number of Inbound Links	Number of Outbound Links	Number of Sources	Number of Drops
Intermediate Nodes Only				
SNCP	2	1	—	—
SNCP	1	2	—	—
Double SNCP	2	2	—	—
Two way	1	1	—	-—
Source or Destination Nodes Only				
Ethernet	1	1	—	—

Table 11-12 Bidirectional Low-Order Tunnels

Number of Inbound Links	Number of Outbound Links	Number of Sources	Number of Drops	Connection Type
Intermediate Nodes Only				
2	1	—	—	SNCP

Table 11-12 Bidirectional Low-Order Tunnels (continued)

Number of Inbound Links	Number of Outbound Links	Number of Sources	Number of Drops	Connection Type
1	2	—	—	SNCP
2	2	—	—	Double SNCP
1	1	—	—	Two way
Source Nodes Only				
—	1	—	—	Low-order tunnel endpoint
Destination Nodes Only				
1	—	—	—	Low-order tunnel endpoint

Although virtual SNCP segments are possible in low-order tunnels, low-order tunnels are still considered unprotected. If you need to protect low-order circuits, use two independent low-order tunnels that are diversely routed or use a low-order tunnel that is routed over 1+1, MS-SPRing, or a mixture of 1+1 and MS-SPRing links.

11.14 Constraint-Based Circuit Routing

When you create circuits, you can choose Fully Protected Path to protect the circuit from source to destination. The protection mechanism used depends on the path CTC calculates for the circuit. If the network is composed entirely of MS-SPRing or 1+1 links, or the path between source and destination can be entirely protected using 1+1 or MS-SPRing links, no path-protected mesh network (Extended SNCP) or virtual SNCP protection is used.

If Extended SNCP protection is needed to protect the path, set the level of node diversity for the Extended SNCP portions of the complete path in the Circuit Creation dialog box:

- Nodal Diversity Required—Ensures that the primary and alternate paths of each Extended SNCP domain in the complete path have a diverse set of nodes.
- Nodal Diversity Desired—CTC looks for a node diverse path; if a node-diverse path is not available, CTC finds a link-diverse path for each Extended SNCP domain in the complete path.
- Link Diversity Only—Creates only a link-diverse path for each Extended SNCP domain.

When you choose automatic circuit routing during circuit creation, you have the option to require or exclude nodes and links in the calculated route. You can use this option to:

- Simplify manual routing, especially if the network is large and selecting every span is tedious. You can select a general route from source to destination and allow CTC to fill in the route details.
- Balance network traffic; by default CTC chooses the shortest path, which can load traffic on certain links while other links have most of their bandwidth available. By selecting a required node or a link, you force the CTC to use (or not use) an element, resulting in more efficient use of network resources.

CTC considers required nodes and links to be an ordered set of elements. CTC treats the source nodes of every required link as required nodes. When CTC calculates the path, it makes sure the computed path traverses the required set of nodes and links and does not traverse excluded nodes and links.

The required nodes and links constraint is only used during the primary path computation and only for Extended SNCP domains/segments. The alternate path is computed normally; CTC uses excluded nodes/links when finding all primary and alternate paths on Extended SNCPs.

11.15 Virtual Concatenated Circuits

Virtual concatenated (VCAT) circuits, also called VCAT groups (VCGs), transport traffic using noncontiguous time division multiplexing (TDM) time slots, avoiding the bandwidth fragmentation problem that exists with contiguous concatenated circuits. The cards that support VCAT circuits are the CE-Series, FC_MR-4 (both enhanced and line rate mode), and ML-Series cards.

In a VCAT circuit, circuit bandwidth is divided into smaller circuits called VCAT members. The individual members act as independent TDM circuits. All VCAT members should be the same size and must originate/terminate at the same end points. For two-fiber MS-SPRing configurations, some members can be routed on protected time slots and others on PCA time slots.

11.15.1 VCAT Circuit States

The state of a VCAT circuit is an aggregate of its member circuits. You can view whether a VCAT member is In Group or Out of Group in the VCAT State column on the Edit Circuits window.

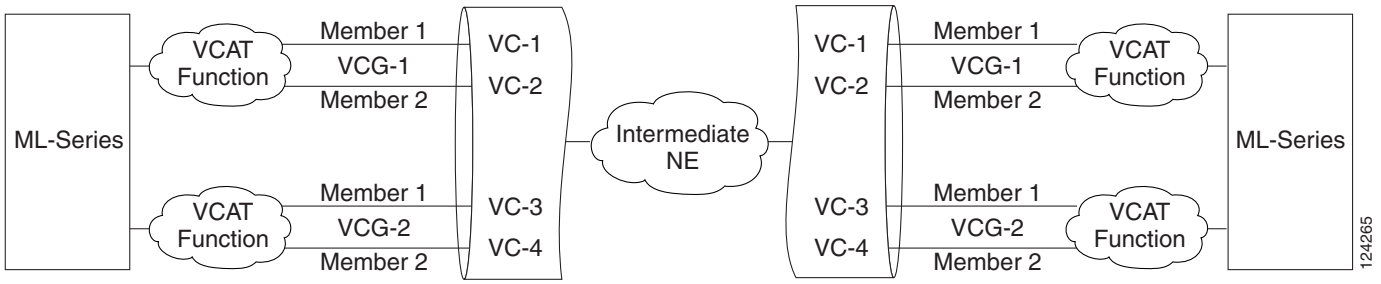
- If all member circuits are Unlocked, the VCAT circuit is Unlocked.
- If all In Group member circuits are Locked, the VCAT circuit state is Locked.
- If no member circuits exist or are all Out of Group, the state of a VCAT circuit is Locked.
- A VCAT circuit is Locked-partial when In Group member states are mixed and all members are not in the Unlocked state.

11.15.2 VCAT Member Routing

The automatic and manual routing selection applies to the entire VCAT circuit, that is, all members are manually or automatically routed. Bidirectional VCAT circuits are symmetric, which means that the same number of members travel in each direction. With automatic routing, you can specify the constraints for individual members; with manual routing, you can select different spans for different members.

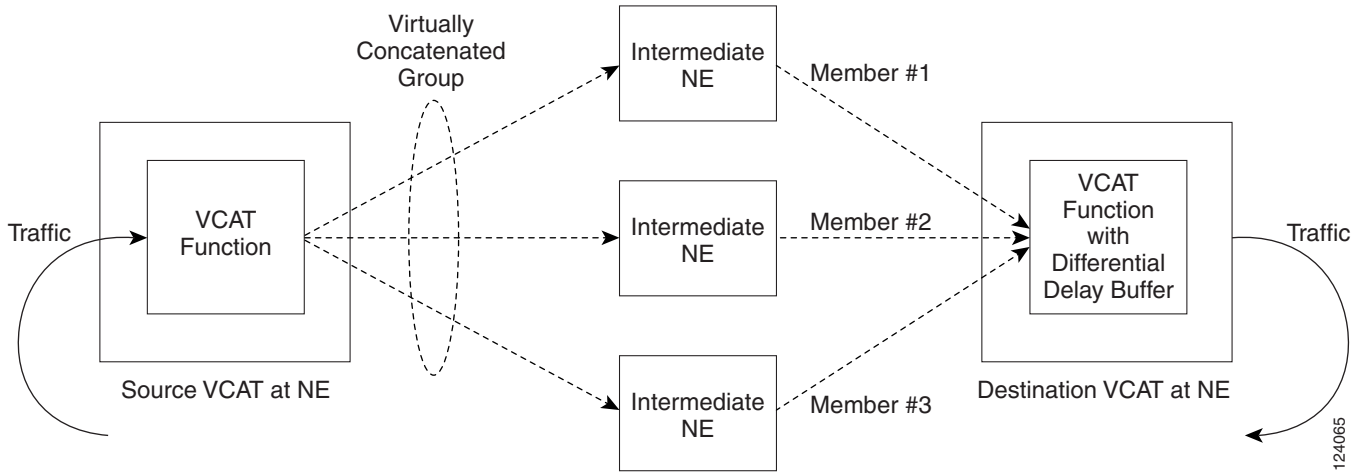
Two types of automatic and manual routing are available for VCAT members: common fiber routing and split routing. CE-Series, FC_MR-4 (both line rate and enhanced mode), and ML-Series cards support common fiber routing. In common fiber routing, all VCAT members travel on the same fibers, which eliminates delay between members. Three protection options are available for common fiber routing: Fully Protected, PCA, and Unprotected. Each member can use a different protection scheme; however, CTC checks the combination to make sure a valid route exists and if it does not, the user must modify the protection type. Figure 11-11 shows an example of common fiber routing.

Figure 11-11 VCAT Common Fiber Routing



CE-Series cards also support split fiber routing, which allows the individual members to be routed on different fibers or each member to have different routing constraints. This mode offers the greatest bandwidth efficiency and also the possibility of differential delay, which is handled by the buffers on the terminating cards. Four protection options are available for split fiber routing: Fully Protected, PCA, Unprotected, and DRI. Figure 11-12 shows an example of split fiber routing.

Figure 11-12 VCAT Split Fiber Routing



11.15.3 Link Capacity Adjustment

The CE-100T-8 card supports the link capacity adjustment scheme (LCAS), which is a signaling protocol that allows dynamic bandwidth adjustment of VCAT circuits. When a member fails, a brief traffic hit occurs. LCAS temporarily removes the failed member from the VCAT circuit for the duration of the failure, leaving the remaining members to carry the traffic. When the failure clears, the member circuit is automatically added back into the VCAT circuit without affecting traffic. You can select LCAS during VCAT circuit creation.

Instead of LCAS, the FC_MR-4 (enhanced mode), CE-1000-4, and ML-Series cards support Software–Link Capacity Adjustment Scheme (SW-LCAS), which uses legacy SONET failure indicators like the AIS-P and RDI-P to detect member failure. If used, SW-LCAS removes the failed member from the VCAT circuit for the duration of the failure, leaving the remaining members to carry the traffic. When the failure clears, the member circuit is added back into the VCAT circuit. SW-LCAS cannot

autonomously remove members that have defects in the H4/Z7 byte. SW-LCAS is only available for legacy SONET defects such as AIS-P, LOP-P, etc. SW-LCAS is optional. You can select SW-LCAS during VCAT circuit creation. The FC_MR-4 card in line rate mode does not support SW-LCAS.

SW-LCAS allows circuit pairing for ML-Series cards over two-fiber MS-SPRing. With circuit pairing, a VCAT circuit is set up between two ML-Series cards: one is a protected circuit (line protection) and the other is PCA. For a four-fiber MS-SPRing, member protection cannot be mixed.

In addition, you can create non-LCAS VCAT circuits, which do not use SW-LCAS. While SW-LCAS member cross-connects can be in different service states, all In Group non-LCAS members must have cross-connects in the same service state. A non-LCAS circuit can mix Out of Group and In Group members if the In Group members are in the same service state. Non-LCAS members do not support the Locked-enabled,outOfGroup service state; to put a non-LCAS member in the Out of Group VCAT state, use Locked-enabled,disabled.

Note Protection switching for LCAS, SW-LCAS, and non-LCAS VCAT circuits might exceed 60ms.

11.15.4 VCAT Circuit Size

Table 11-13 lists supported circuit rates and number of members for each card.

Table 11-13 ONS 15454 SDH Card VCAT Circuit Rates and Members

Card	Circuit Rate	Number of Members
CE-100T-8	VC12	1–64
	VC3	1–3[1]
CE-1000-4	VC4	1–7[1]
FC_MR-4 (Line rate mode)	VC4	8 (1-Gbps port) 16 (2-Gbps port)
FC_MR-4 (Enhanced mode)	VC4	1–8 (1-Gbps port) 1–16 (2-Gbps port)
ML-Series	VC3, VC4, VC4-4c	2

1. A VCAT circuit with a CE-Series card as a source or destination and an ML-Series card as a source or destination can have only two members.

Use the Members tab in the Edit Circuit window to add or delete members from a VCAT circuit. The capability to add or delete members depends on the card and whether the VCAT circuit is LCAS, SW-LCAS, or non-LCAS.

- CE-100T-8 cards—Before deleting a member of an LCAS VCAT circuit, Cisco recommends that you put the member in the Locked-enabled,outOfGroup service state. If you create non-LCAS VCAT circuits on the CE-Series card, adding members to the circuit is possible, but service-affecting. You cannot delete members from non-LCAS VCAT circuits without affecting the entire VCAT circuit.
- CE-1000-4 cards—You can add or delete SW-LCAS VCAT members, although it might affect service. Before deleting a member, Cisco recommends that you put the member in the Locked-enabled,outOfGroup service state. If you create non-LCAS VCAT circuits , adding and deleting members to the circuit is possible, but service-affecting.

- FC_MR-4 (enhanced mode) card—You can add or delete SW-LCAS VCAT members, although it might affect service. Before deleting a member, Cisco recommends that you put the member in the Locked-enabled,outOfGroup service state. You cannot add or delete members from VCAT circuits without SW-LCAS.
- FC_MR-4 (line rate mode) card—All VCAT circuits using FC_MR-4 (line rate mode) cards have a fixed number of members; you cannot add or delete members.
- ML-Series card—All VCAT circuits using ML-Series cards have a fixed number of members; you cannot add or delete members.

Table 11-14 summarizes the VCAT capabilities for each card.

Table 11-14 ONS 15454 SDH VCAT Card Capabilities

Card	Mode	Add a Member	Delete a Member	Support Locked-enabled, outOfGroup
CE-100T-8	LCAS	Yes[1]	Yes[1]	Yes
	SW-LCAS	No	No	No
	Non-LCAS	Yes[2]	Yes[2]	No
CE-1000-4	LCAS	No	No	No
	SW-LCAS	Yes	Yes	Yes
	Non-LCAS	Yes[2]	Yes[2]	No
FC_MR-4 (enhanced mode)	SW-LCAS	Yes	Yes	Yes
	Non-LCAS	No	No	No
FC_MR-4 (line mode)	Non-LCAS	No	No	No
ML-Series	SW-LCAS	No	No	No
	Non-LCAS	No	No	No

1. When adding or deleting a member from an LCAS VCAT circuit, Cisco recommends that you first put the member in the OOS-MA,OOG service state to avoid service disruptions.
2. For CE-Series cards, you can add or delete members after creating a VCAT circuit with no protection. During the time it takes to add or delete members (from seconds to minutes), the entire VCAT circuit will be unable to carry traffic.

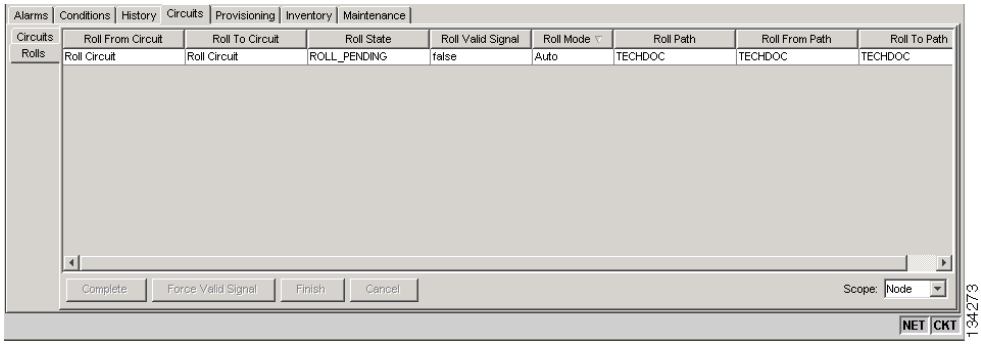
11.16 Bridge and Roll

The CTC Bridge and Roll wizard reroutes live traffic without interrupting service. The bridge process takes traffic from a designated “roll from” facility and establishes a cross-connect to the designated “roll to” facility. When the bridged signal at the receiving end point is verified, the roll process creates a new cross-connect to receive the new signal. When the roll completes, the original cross-connects are released. You can use the bridge and roll feature for maintenance functions such as card or facility replacement, or for load balancing. You can perform a bridge and roll on the following ONS platforms: ONS 15600, ONS 15454, ONS 15454 SDH, ONS 15327, and ONS 15310-CL.

11.16.1 Rolls Window

The Rolls window lists information about a rolled circuit before the roll process is complete. You can access the Rolls window by clicking the Circuits > Rolls tabs in either network or node view. Figure 11-13 shows the Rolls window.

Figure 11-13 Rolls Window



The Rolls window information includes:

- Roll From Circuit—The circuit with connections that will no longer be used when the roll process is complete.
- Roll To Circuit—The circuit that will carry the traffic when the roll process is complete. The Roll To Circuit is the same as the Roll From Circuit if a single circuit is involved in a roll.
- Roll State—The roll status; see the "11.16.2 Roll Status" section on page 11-30 for information.
- Roll Valid Signal—If the Roll Valid Signal status is true, a valid signal was found on the new port. If the Roll Valid Signal status is false, a valid signal was not found. It is not possible to get a true Roll Valid Signal status for a one-way destination roll.
- Roll Mode—The mode indicates whether the roll is automatic or manual.

  CTC implements a roll mode at the circuit level. TL1 implements a roll mode at the cross-connect level. If a single roll is performed, CTC and TL1 behave the same. If a dual roll is performed, the roll mode specified in CTC might be different than the roll mode retrieved in TL1. For example, if you select Automatic, CTC coordinates the two rolls to minimize possible traffic hits by using the Manual mode behind the scenes. When both rolls have a good signal, CTC signals the nodes to complete the roll.

  - Automatic—When a valid signal is received on the new path, CTC completes the roll on the node automatically. One-way source rolls are always automatic.
  - Manual—You must complete a manual roll after a valid signal is received. One-way destination rolls are always manual.
- Roll Path—The fixed point of the roll object.
- Roll From Path— The old path that is being rerouted.
- Roll To Path—The new path where the Roll From Path is rerouted.
- Complete—Completes a manual roll after a valid signal is received. You can complete a manual roll if it is in a ROLL_PENDING status and you have not yet completed the roll or have not cancelled its sibling roll.

- Force Valid Signal—Forces a roll onto the Roll To Circuit destination without a valid signal. If you choose Force Valid Signal, traffic on the circuit that is involved in the roll will be dropped when the roll is completed.
- Finish—Completes the circuit processing of both manual and automatic rolls and changes the circuit status from ROLL_PENDING to DISCOVERED. After a roll, the Finish button also removes any cross-connects that are no longer used from the Roll From Circuit field.
- Cancel—Cancels the roll process. When the roll mode is Manual, cancel roll is only allowed before you click the Complete button. When the roll mode is Auto, cancel roll is only allowed before a good signal is detected by the node or before you click the Force Valid Signal button.

11.16.2 Roll Status

Table 11-15 lists the roll statuses. You can only reroute circuits that have a DISCOVERED status. (See Table 11-2 on page 11-6 for a list of circuit statuses.) You cannot reroute circuits that are in the ROLL_PENDING status.

Table 11-15 Roll Statuses

State	Description
ROLL_PENDING	The roll is awaiting completion or cancellation.
ROLL_COMPLETED	The roll is complete. Click the Finish button.
ROLL_CANCELLED	The roll has been canceled.
TL1_ROLL	A TL1 roll was initiated. **Note** If a roll is created using TL1, a CTC user cannot complete or cancel the roll. Also, if a roll is created using CTC, a TL1 user cannot complete or cancel the roll. You must use the same interface to complete or change a roll.
INCOMPLETE	This state appears when the underlying circuit becomes incomplete. To correct this state, you must fix the underlying circuit problem before the roll state will change. For example, a circuit traveling on Nodes A, B, and C can become INCOMPLETE if Node B is rebooted. The cross-connect information is lost on Node B during a reboot. The Roll State on Nodes A and C will change to INCOMPLETE.

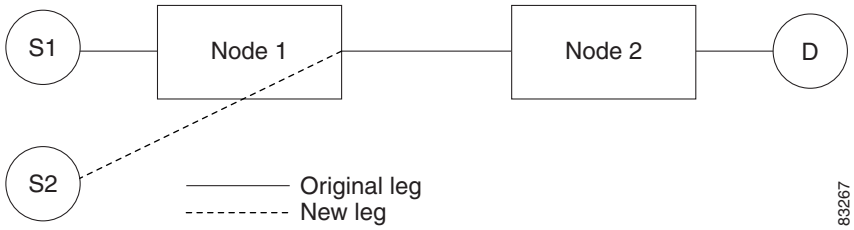
11.16.3 Single and Dual Rolls

Circuits have an additional layer of roll types: single and dual. A single roll on a circuit is a roll on one of its cross-connects. Use a single roll to:

- Change either the source or destination of a selected circuit (Figure 11-14 and Figure 11-15, respectively).
- Roll a segment of the circuit onto another chosen circuit (Figure 11-16 on page 11-31). This roll also results in a new destination or a new source.

In Figure 11-14, you can select any available VC4 on Node 1 for a new source.

Figure 11-14 Single Source Roll



In Figure 11-15, you can select any available VC4 on Node 2 for a new destination.

Figure 11-15 Single Destination Roll

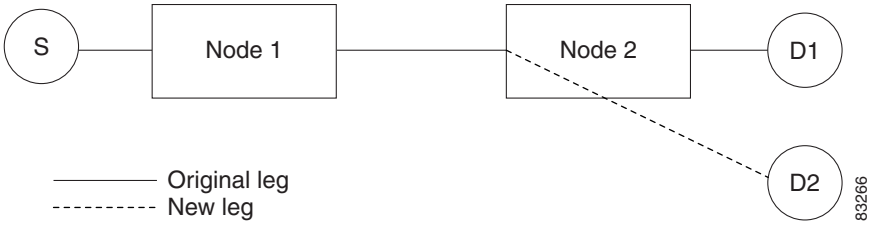


Figure 11-16 shows one circuit rolling onto another circuit at the destination. The new circuit has cross-connects on Node 1, Node 3, and Node 4. CTC deletes the cross-connect on Node 2 after the roll.

Figure 11-16 Single Roll from One Circuit to Another Circuit (Destination Changes)

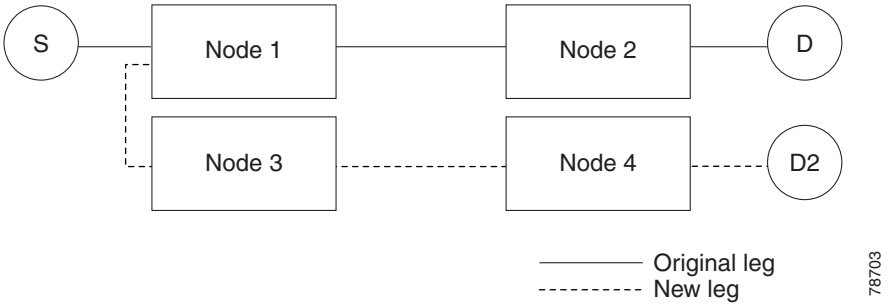
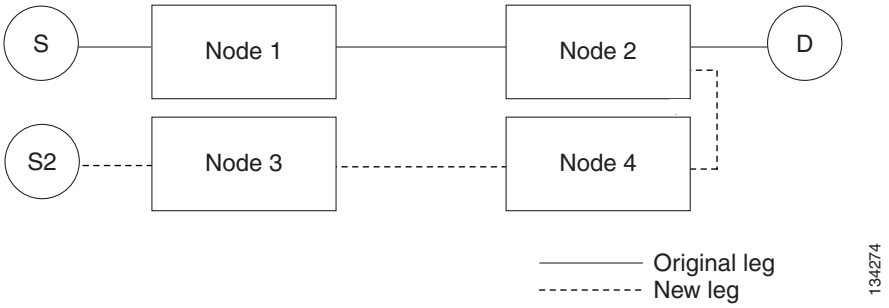


Figure 11-17 shows one circuit rolling onto another circuit at the source.

Figure 11-17 Single Roll from One Circuit to Another Circuit (Source Changes)



Note Create a Roll To Circuit before rolling a circuit with the source on Node 3 and the destination on Node 4.

A dual roll involves two cross-connects. It allows you to reroute intermediate segments of a circuit, but keep the original source and destination. If the new segments require new cross-connects, use the Bridge and Roll wizard or create a new circuit and then perform a roll.

Dual rolls have several constraints:

- You must complete or cancel both cross-connects rolled in a dual roll. You cannot complete one roll and cancel the other roll.
- When a Roll To circuit is involved in the dual roll, the first roll must roll onto the source of the Roll To circuit and the second roll must roll onto the destination of the Roll To circuit.

Figure 11-18 illustrates a dual roll on the same circuit.

Figure 11-18 Dual Roll to Reroute a Link

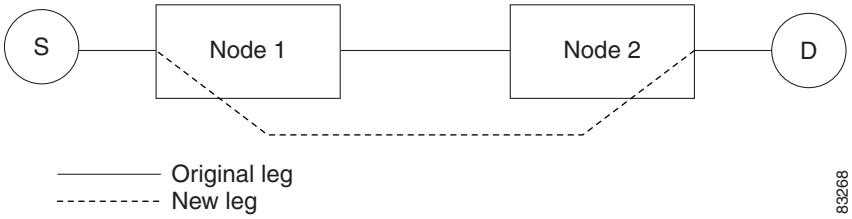
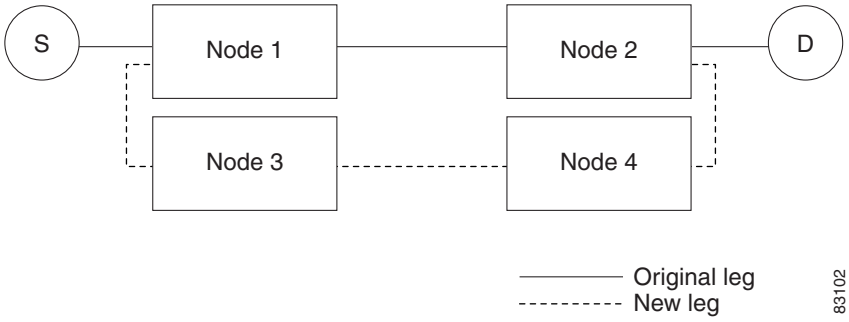


Figure 11-19 illustrates a dual roll involving two circuits.

Figure 11-19 Dual Roll to Reroute to a Different Node



Note If a new segment is created on Nodes 3 and 4 using the Bridge and Roll wizard, the created circuit has the same name as the original circuit with the suffix _ROLL**. The circuit source is on Node 3 and the circuit destination is on Node 4.

11.16.4 Two Circuit Bridge and Roll

When using the bridge and roll feature to reroute traffic using two circuits, the following constraints apply:

- DCC must be enabled on the circuits involved in a roll before roll creation.

- A maximum of two rolls can exist between any two circuits.
- If two rolls are involved between two circuits, both rolls must be on the original circuit. The second circuit should not carry live traffic. The two rolls loop from the second circuit back to the original circuit. The roll mode of the two rolls must be identical (either automatic or manual).
- If a single roll exists on a circuit, you must roll the connection onto the source or the destination of the second circuit and not an intermediate node in the circuit.

11.16.5 Protected Circuits

CTC allows you to roll the working or protect path regardless of which path is active. You can upgrade an unprotected circuit to a fully protected circuit or downgrade a fully protected circuit to an unprotected circuit with the exception of an SNCP circuit. When using bridge and roll on SNCP circuits, you can roll the source or destination or both path selectors in a dual roll. However, you cannot roll a single path selector.

11.17 Merged Circuits

A circuit merge combines a single selected circuit with one or more circuits. You can merge VCTs, VCA circuits, VLAN-assigned circuits, VCAT members, orderwire and user data channel overhead circuits, CTC-created traffic circuits, and TL1-created traffic circuits. To merge circuits, you choose a circuit on the CTC Circuits tab and the circuits that you want to merge with the chosen (master) circuit on the Merge tab in the Edit Circuits window. The Merge tab shows only the circuits that are available for merging with the master circuit:

- Circuit cross-connects must create a single, contiguous path.
- Circuit types must be a compatible. For example, you can combine a HOP with a VCA circuit to create a longer VCA circuit, but you cannot combine a LOP with a HOP.
- Circuit directions must be compatible. You can merge a one-way and a two-way circuit, but not two one-way circuits in opposing directions.
- Circuit sizes must be identical.
- VLAN assignments must be identical.
- Circuit end points must send or receive the same framing format.
- The merged circuits must become a DISCOVERED circuit.

If all connections from the master circuit and all connections from the merged circuits align to form one complete circuit, the merge is successful. If all connections from the master circuit and some, but not all, connections from the other circuits align to form a single complete circuit, CTC notifies you and gives you the chance to cancel the merge process. If you choose to continue, the aligned connections merge successfully into the master circuit, and unaligned connections remain in the original circuits. All connections in the completed master circuit use the original master circuit name.

All connections from the master circuit and at least one connection from the other selected circuits must be used in the resulting circuit for the merge to succeed. If a merge fails, the master circuit and all other circuits remain unchanged. When the circuit merge completes successfully, the resulting circuit retains the name of the master circuit.

11.18 Reconfigured Circuits

You can reconfigure multiple circuits, which is typically necessary when a large number of circuits are in the PARTIAL state. When reconfiguring multiple circuits, the selected circuits can be any combination of DISCOVERED, PARTIAL, DISCOVERED_TL1, or PARTIAL_TL1 circuits. You can reconfigure VCTs, VCA circuits, VLAN-assigned circuits, VCAT circuits, CTC-created circuits, and TL1-created circuits. The Reconfigure command maintains the names of the original cross-connects.

Use the CTC Tools > Circuits > Reconfigure Circuits command to reconfigure selected circuits. During reconfiguration, CTC reassembles all connections of the selected circuits into circuits based on path size, direction, and alignment. Some circuits might merge and others might split into multiple circuits. If the resulting circuit is a valid circuit, it appears as a DISCOVERED circuit. Otherwise, the circuit appears as a PARTIAL or PARTIAL_TL1 circuit.

Note If CTC cannot reconfigure all members in a VCAT circuit, the reconfigure operation fails for the entire VCAT circuit and it remains in the PARTIAL or PARTIAL_TL1 status. If CTC does reconfigure all members in a VCAT circuit, the VCAT circuit may still remain in the PARTIAL or PARTIAL_TL1 status. This occurs if the ports defined in the VCAT termination do not match the source/drop ports of the member circuits or if one or two VCAT terminations are missing.

Note PARTIAL tunnel and PARTIAL VLAN-capable circuits do not split into multiple circuits during reconfiguration.

11.19 Server Trails

A server trail is a non-DCC link across a third-party network that connects two CTC network domains. A server trail allows circuit provisioning when no DCC is available. You can create server trails between any two STM-N ports. Server trails are not allowed on DCC-enabled ports.

The server trail link is bidirectional and can be VC4-2c, VC4-3c, VC4-4c, VC4-6c, VC4-8c, VC4-12c, VC4-16c, VC4-64c, VC4, VC3, VC12, or VC11; you cannot upgrade an existing server trail to another size. A server trail link can be one of the following protection types: Preemptible, Unprotected, and Fully Protected. The server trail protection type determines the protection type for any circuits that traverse it. PCA circuits will use server trails with the Preemptible attribute.

When creating circuits or VCATs, you can choose a server trail link during manual circuit routing. CTC may also route circuits over server trail links during automatic routing. VCAT common-fiber automatic routing is not supported.

CHAPTER 12

SDH Topologies and Upgrades

This chapter explains Cisco ONS 15454 SDH topologies and upgrades. To provision topologies, refer to the *Cisco ONS 15454 SDH Procedure Guide*.

Chapter topics include:

- 12.1 SDH Rings and TCC2/TCC2P Cards, page 12-1
- 12.2 Multiplex Section-Shared Protection Rings, page 12-2
- 12.3 Subnetwork Connection Protection, page 12-13
- 12.4 Dual Ring Interconnect, page 12-18
- 12.5 Subtending Rings, page 12-25
- 12.6 Linear ADM Configurations, page 12-27
- 12.7 Extended SNCP Mesh Networks, page 12-28
- 12.8 Four Node Configurations, page 12-30
- 12.9 STM-N Speed Upgrades, page 12-30

12.1 SDH Rings and TCC2/TCC2P Cards

Table 12-1 shows the SDH rings that can be created on each ONS 15454 SDH node using redundant TCC2/TCC2P cards.

Table 12-1 ONS 15454 SDH Rings with Redundant TCC2/TCC2P Cards

Ring Type	Maximum Rings per Node
MS-SPRings[1]	5
2-Fiber MS-SPRings	5
4-Fiber MS-SPRings	1
SNCP with RS-DCC	34[2] [3]
SNCP with MS-DCC	14[4] [5]
SNCP with MS-DCC and RS-DCC	26[6]

1. MS-SPRing = multiplex section-shared protection ring
2. Total RS-DCC usage must be equal to or less than 84 RS-DCCs.
3. See the "12.3 Subnetwork Connection Protection" section on page 12-13.

4. Total MS-DCC usage must be equal to or less than 28 MS-DCCs.
5. See the "12.3 Subnetwork Connection Protection" section on page 12-13.
6. Total MS-DCC and RS-DCC usage must be equal to or less than 84. When MS-DCC is provisioned, an RS-DCC termination is allowed on the same port, but is not recommended. Using RS-DCC and MS-DCC on the same port is only needed during a software upgrade if the other end of the link does not support MS-DCC. You can provision RS-DCCs and MS-DCCs on different ports in the same node.

12.2 Multiplex Section-Shared Protection Rings

There are two types of MS-SPRings: two-fiber and four-fiber. Two-fiber MS-SPRings share service and protection equally, but only two physical fibers are required. For more information, see the "12.2.1 Two-Fiber MS-SPRings" section on page 12-2. With four-fiber MS-SPRings, the nodes on both sides of the failed span perform a span switch and use the second pair of fibers as the new working route. For more information, see the "12.2.2 Four-Fiber MS-SPRings" section on page 12-5.

The ONS 15454 SDH can support five concurrent MS-SPRings in one of the following configurations:

- Five two-fiber MS-SPRings
- Four two-fiber and one four-fiber MS-SPRings

Each MS-SPRing can have up to 32 ONS 15454 SDH nodes. Because the working and protect bandwidths must be equal, you can create only STM-4 (two-fiber only), STM-16, or STM-64 MS-SPRings. For information about MS-SPRing protection channels, see the "11.8 MS-SPRing Protection Channel Access Circuits" section on page 11-16.

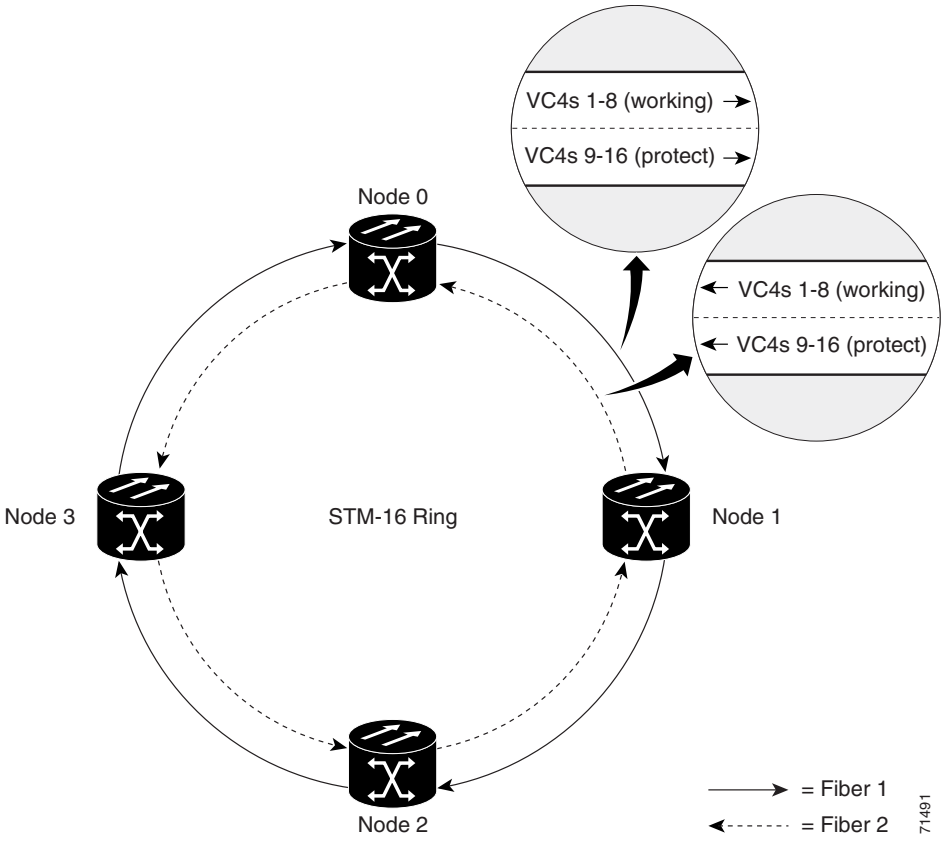
Note MS-SPRings with 16 or fewer nodes have a switch time of 50ms. MS-SPRings with 16 or more nodes have a switch time of 100 ms.

Note For best performance, MS-SPRings should have one LAN connection for every ten nodes in the MS-SPRing.

12.2.1 Two-Fiber MS-SPRings

In two-fiber MS-SPRings, each fiber is divided into working and protect bandwidths. For example, in an STM-16 MS-SPRing (Figure 12-1), VC4s 1 to 8 carry the working traffic, and VC4s 9 to 16 are reserved for protection. Working traffic (VC4s 1 to 8) travels in one direction on one fiber and in the opposite direction on the second fiber. The Cisco Transport Controller (CTC) circuit routing routines calculate the "shortest path" for circuits based on many factors, including user requirements, traffic patterns, and distance. For example, in Figure 12-1, circuits going from Node 0 to Node 1 typically travel on Fiber 1, unless that fiber is full, in which case circuits are routed on Fiber 2 through Node 3 and Node 2. Traffic from Node 0 to Node 2 (or Node 1 to Node 3), can be routed on either fiber, depending on circuit provisioning requirements and traffic loads.

Figure 12-1 Four-Node, Two-Fiber MS-SPRing



The SDH K1, K2, and K3 bytes carry the information that governs MS-SPRing protection switches. Each MS-SPRing node monitors the K bytes to determine when to switch the SDH signal to an alternate physical path. The K bytes communicate failure conditions and actions taken between nodes in the ring.

If a break occurs on one fiber, working traffic targeted for a node beyond the break switches to the protect bandwidth on the second fiber. The traffic travels in a reverse direction on the protect bandwidth until it reaches its destination node. At that point, traffic is switched back to the working bandwidth.

Figure 12-2 shows a sample traffic pattern on a four-node, two-fiber MS-SPRing.

Figure 12-2 Four-Node, Two-Fiber MS-SPRing Traffic Pattern

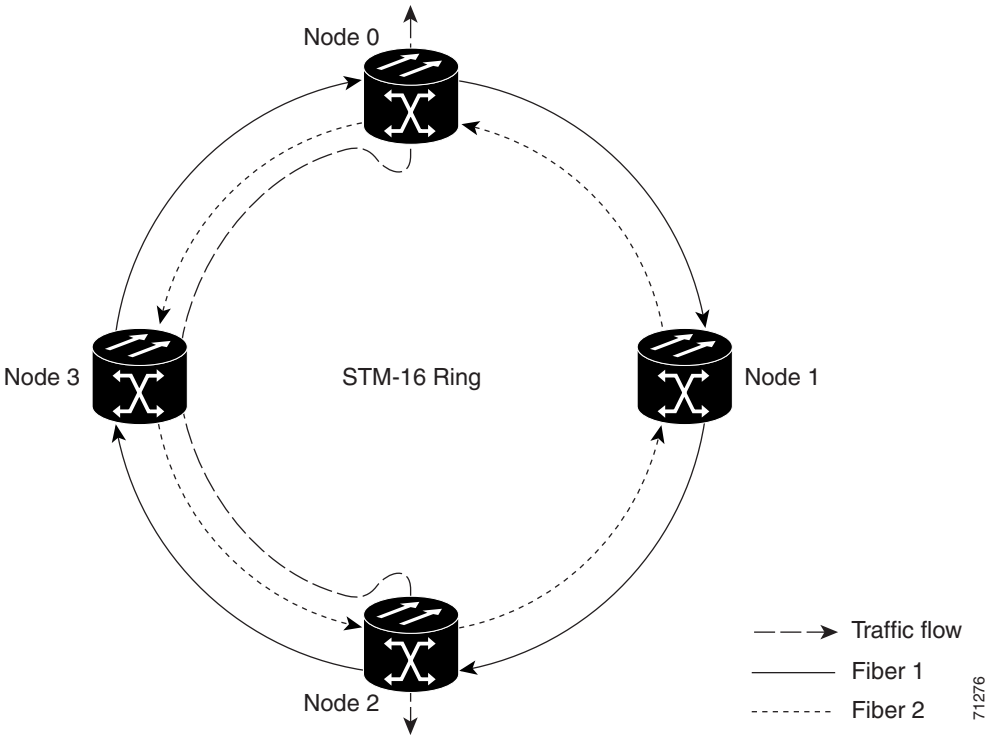
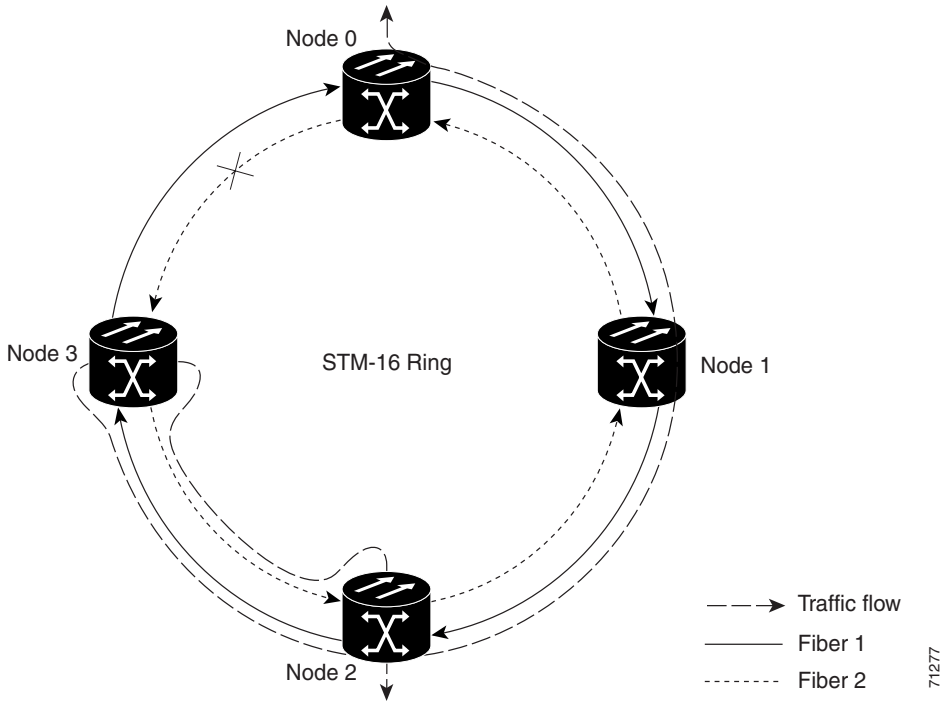


Figure 12-3 shows how traffic is rerouted after a line break between Node 0 and Node 3.

- All circuits originating on Node 0 and carried to Node 2 on Fiber 2 are switched to the protect bandwidth of Fiber 1. For example, a circuit carried on VC4-1 on Fiber 2 is switched to VC4-9 on Fiber 1. A circuit carried on VC4-2 on Fiber 2 is switched to VC4-10 on Fiber 1. Fiber 1 carries the circuit to Node 3 (the original routing destination). Node 3 switches the circuit back to VC4-1 on Fiber 2 where it is routed to Node 2 on VC4-1.
- Circuits originating on Node 2 that were normally carried to Node 0 on Fiber 1 are switched to the protect bandwidth of Fiber 2 at Node 3. For example, a circuit carried on VC4-2 on Fiber 1 is switched to VC4-10 on Fiber 2. Fiber 2 carries the circuit to Node 0 where the circuit is switched back to VC4-2 on Fiber 1 and then dropped to its destination.

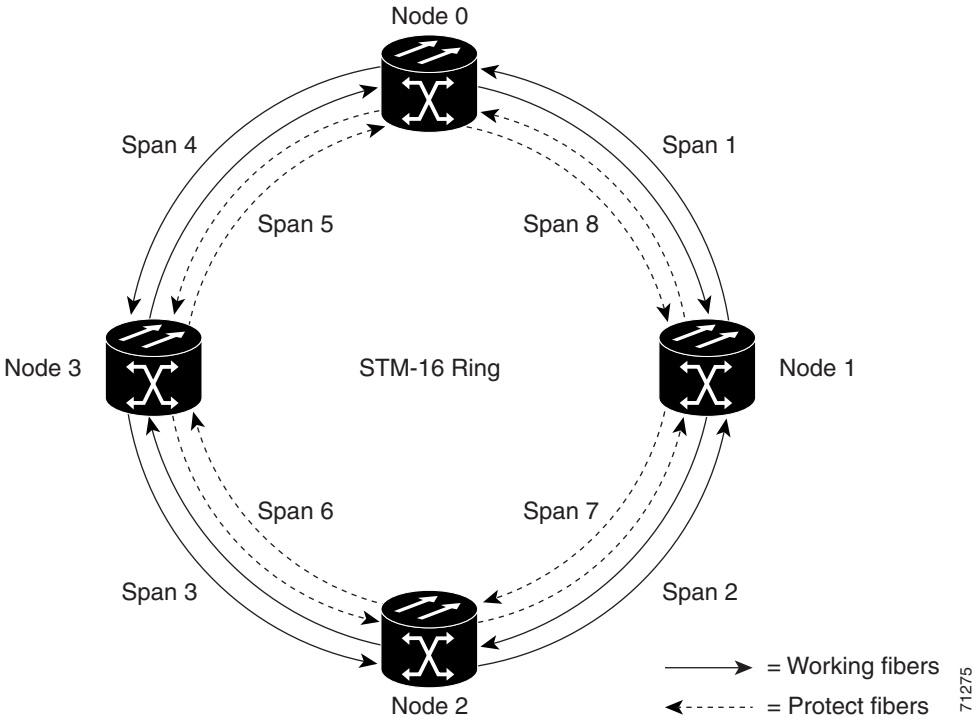
Figure 12-3 Four-Node, Two-Fiber MS-SPRing Traffic Pattern After Line Break



12.2.2 Four-Fiber MS-SPRings

Four-fiber MS-SPRings double the bandwidth of two-fiber MS-SPRings. Because they allow span switching as well as ring switching, four-fiber MS-SPRings increase the reliability and flexibility of traffic protection. Two fibers are allocated for working traffic and two fibers for protection, as shown in Figure 12-4. To implement a four-fiber MS-SPRing, you must install four STM-16 cards or four STM-64 cards at each MS-SPRing node.

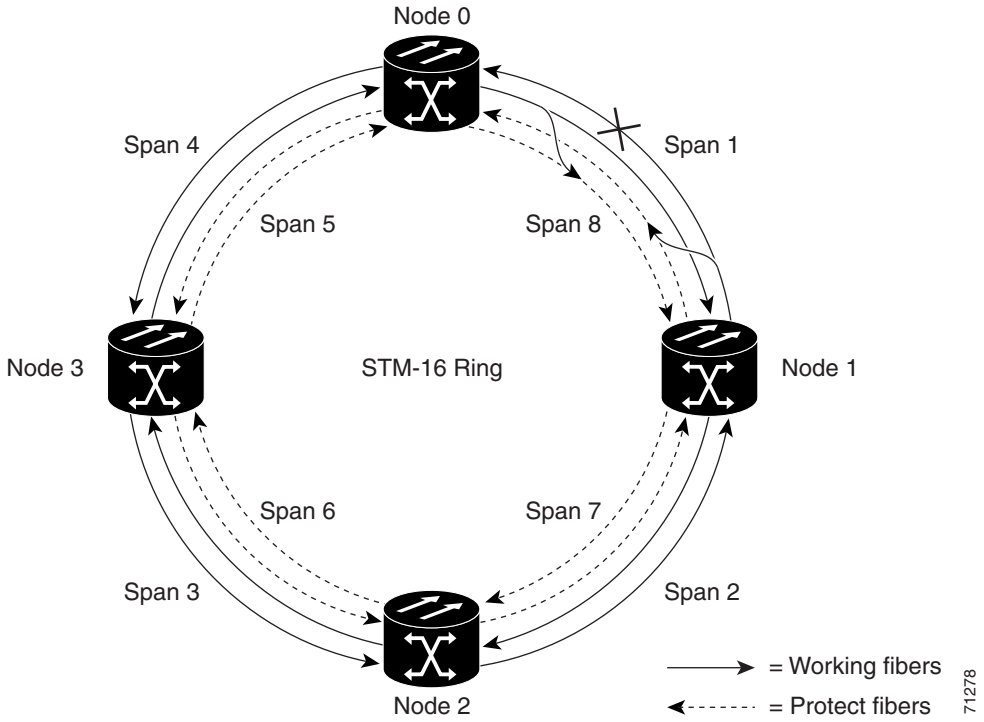
Figure 12-4 Four-Node, Four-Fiber MS-SPRing



Four-fiber MS-SPRings provide span and ring switching.

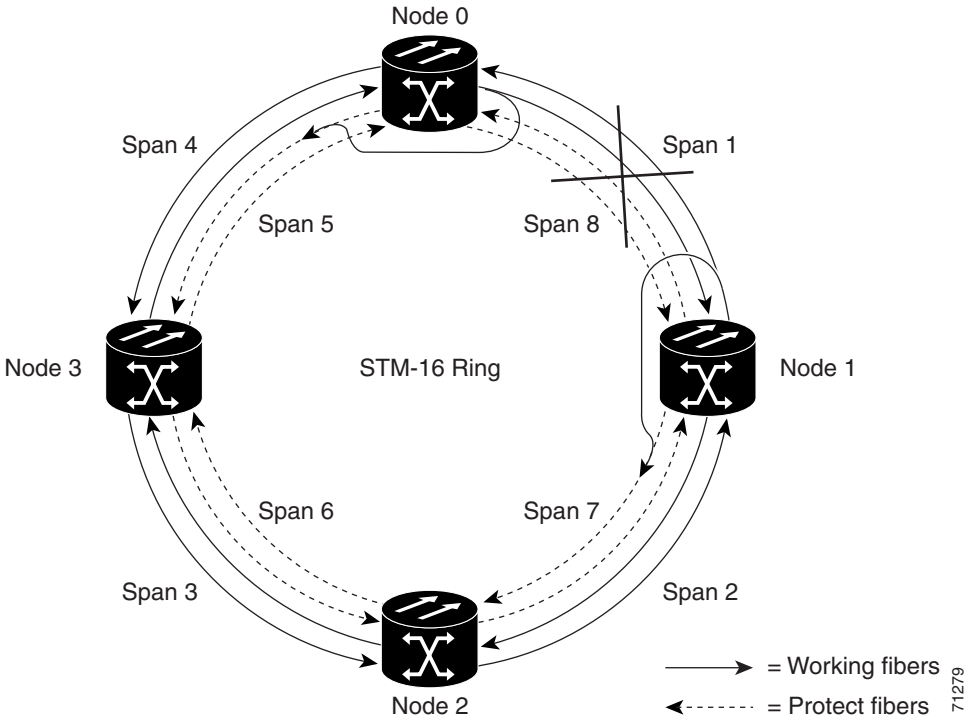
Span switching occurs when a working span fails (Figure 12-5). Traffic switches to the protect fibers between the nodes (Node 0 and Node 1 in the Figure 12-5 example) and then returns to the working fibers that did not fail. Multiple span switches can occur at the same time.

Figure 12-5 Four-Fiber MS-SPRing Span Switch



Ring switching occurs when a span switch cannot recover traffic (Figure 12-6), such as when both the working and protect fibers fail on the same span. In a ring switch, traffic is routed to the protect fibers throughout the full ring.

Figure 12-6 Four-Fiber MS-SPRing Switch



12.2.3 MS-SPRing Bandwidth

An MS-SPRing node can terminate traffic it receives from either side of the ring. Therefore, MS-SPRings are suited for distributed node-to-node traffic applications such as interoffice networks and access networks.

MS-SPRings share the ring bandwidth equally between working and protection traffic. Half of the payload bandwidth is reserved for protection in each direction, making the communication pipe half-full under normal operation.

MS-SPRings allow bandwidth to be reused around the ring and can carry more traffic than a network with traffic flowing through one central hub. MS-SPRings can also carry more traffic than an SNCP ring operating at the same STM-N rate. Table 12-2 shows the bidirectional bandwidth capacities of two-fiber MS-SPRings. The capacity is the STM-N rate divided by two, multiplied by the number of nodes in the ring and minus the number of pass-through VC4 circuits.

Table 12-2 Two-Fiber MS-SPRing Capacity

STM Rate	Working Bandwidth	Protection Bandwidth	Ring Capacity
STM-4	VC4 1-2	VC4 3-4	2 x N[1] – PT[2]
STM-16	VC4 1-8	VC4 9-16	8 x N – PT
STM-64	VC4 1-32	VC4 33-64	32 x N – PT

1. N equals the number of ONS 15454 SDH nodes configured as MS-SPRing nodes.
2. PT equals the number of VC4 circuits passed through ONS 15454 SDH nodes in the ring. (Capacity can vary depending on the traffic pattern.)

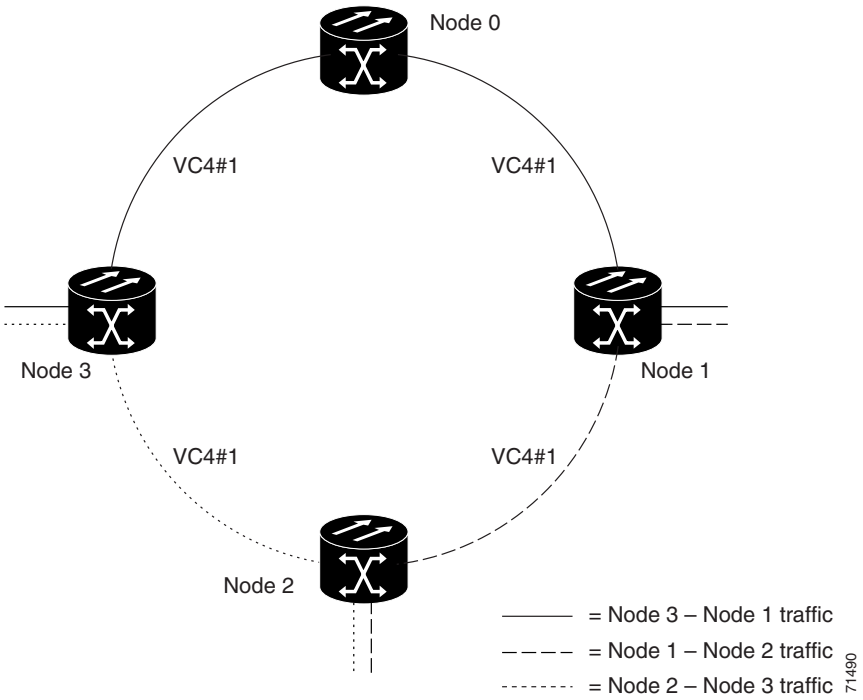
Table 12-3 shows the bidirectional bandwidth capacities of four-fiber MS-SPRings.

Table 12-3 Four-Fiber MS-SPRing Capacity

STM Rate	Working Bandwidth	Protection Bandwidth	Ring Capacity
STM-16	VC4 1-16 (Fiber 1)	VC4 1-16 (Fiber 2)	16 x N – PT
STM-64	VC4 1-64 (Fiber 1)	VC4 1-64 (Fiber 2)	64 x N – PT

Figure 12-7 shows an example of MS-SPRing bandwidth reuse. The same VC4 carries three different traffic sets simultaneously on different spans on the ring: one set from Node 3 to Node 1, one set from Node 1 to Node 2, and another set from Node 2 to Node 3.

Figure 12-7 MS-SPRing Bandwidth Reuse



12.2.4 MS-SPRing Application Sample

Figure 12-8 shows a sample two-fiber MS-SPRing implementation with five nodes. A regional long-distance network connects to other carriers at Node 0. Traffic is delivered to the service provider's major hubs.

- Carrier 1 delivers six E-3s over two STM-1 spans to Node 0. Carrier 2 provides twelve E-3s directly. Node 0 receives the signals and delivers them around the ring to the appropriate node.
- The ring also brings 14 E-1s back from each remote site to Node 0. Intermediate nodes serve these shorter regional connections.
- The ONS 15454 SDH STM-1 card supports a total of four STM-1 ports so that two additional STM-1 spans can be added at little cost.

Figure 12-8 Five-Node, Two-Fiber MS-SPRing

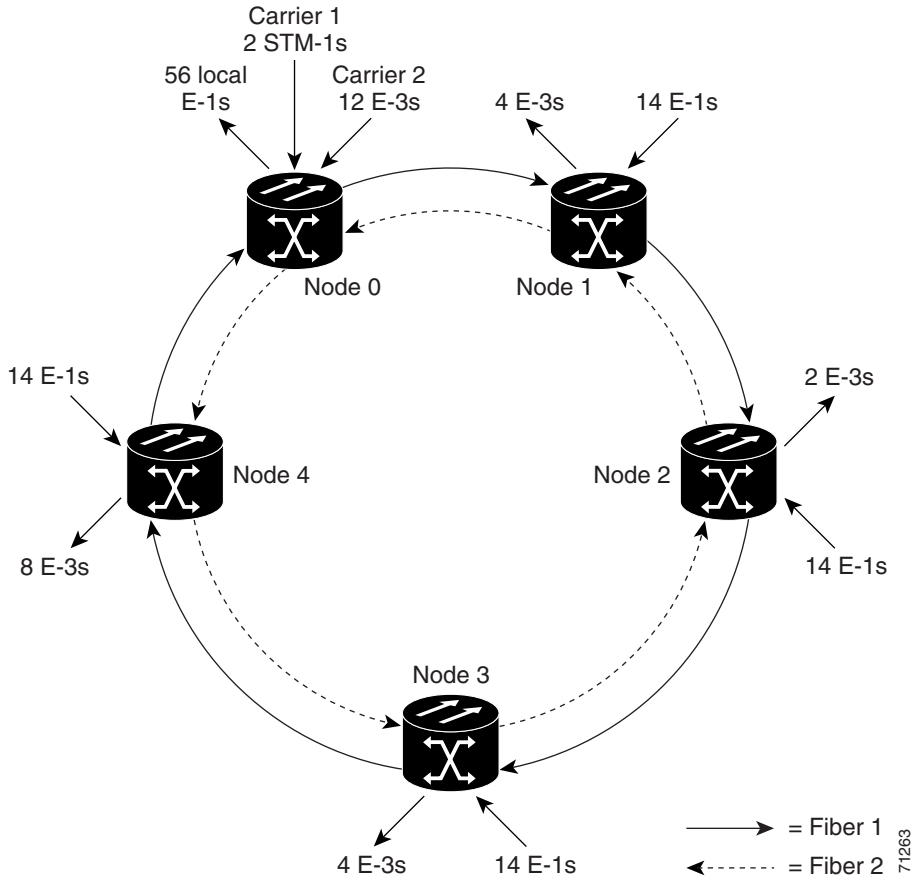


Figure 12-9 shows the shelf assembly layout for Node 0, which has one free slot.

Figure 12-9 Shelf Assembly Layout for Node 0 in Figure 12-8

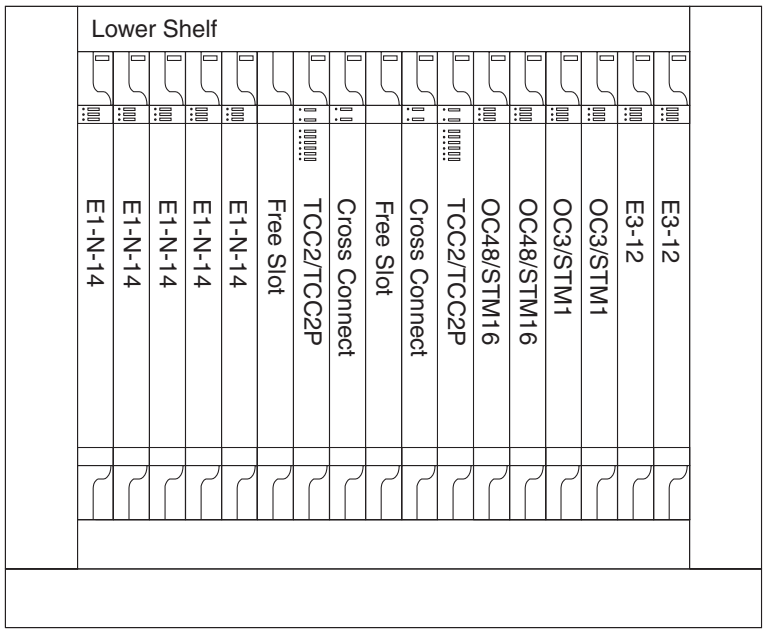
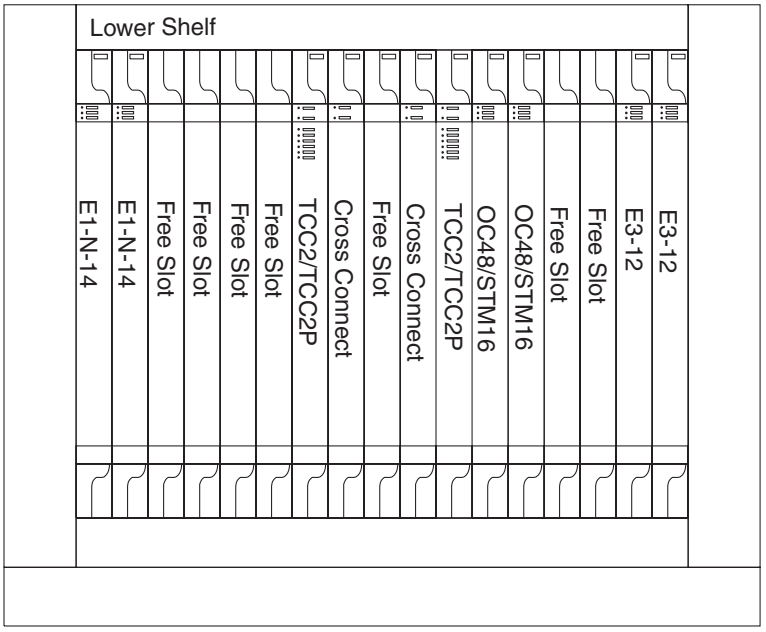


Figure 12-10 shows the shelf assembly layout for the remaining sites in the ring. In this MS-SPRing configuration, an additional eight E-3s at Node IDs 1 and 3 can be activated. An additional four E-3s can be added at Node ID 4, and ten E-3s can be added at Node ID 2. Each site has free slots for future traffic needs.

Figure 12-10 Shelf Assembly Layout for Nodes 1 to 4 in Figure 12-8

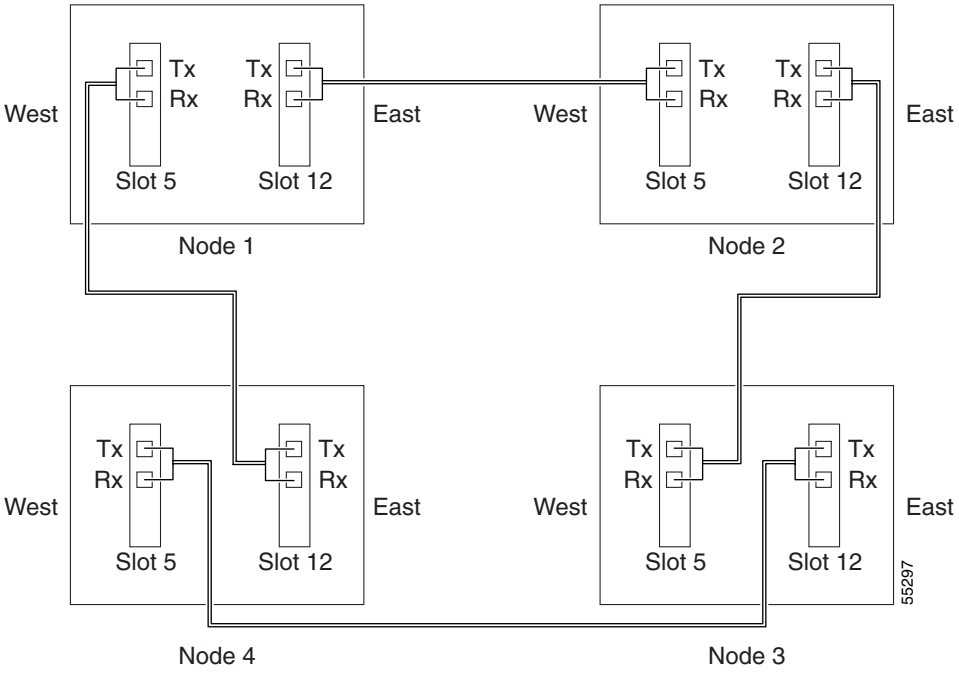


12.2.5 MS-SPRing Fiber Connections

Plan your fiber connections and use the same plan for all MS-SPRing nodes. For example, make the east port the farthest slot to the right and the west port the farthest slot to the left. Plug fiber connected to an east port at one node into the west port on an adjacent node. Figure 12-11 shows fiber connections for a two-fiber MS-SPRing with trunk cards in Slot 5 (west) and Slot 12 (east). Refer to the *Cisco ONS 15454 SDH Procedure Guide* for fiber connection procedures.

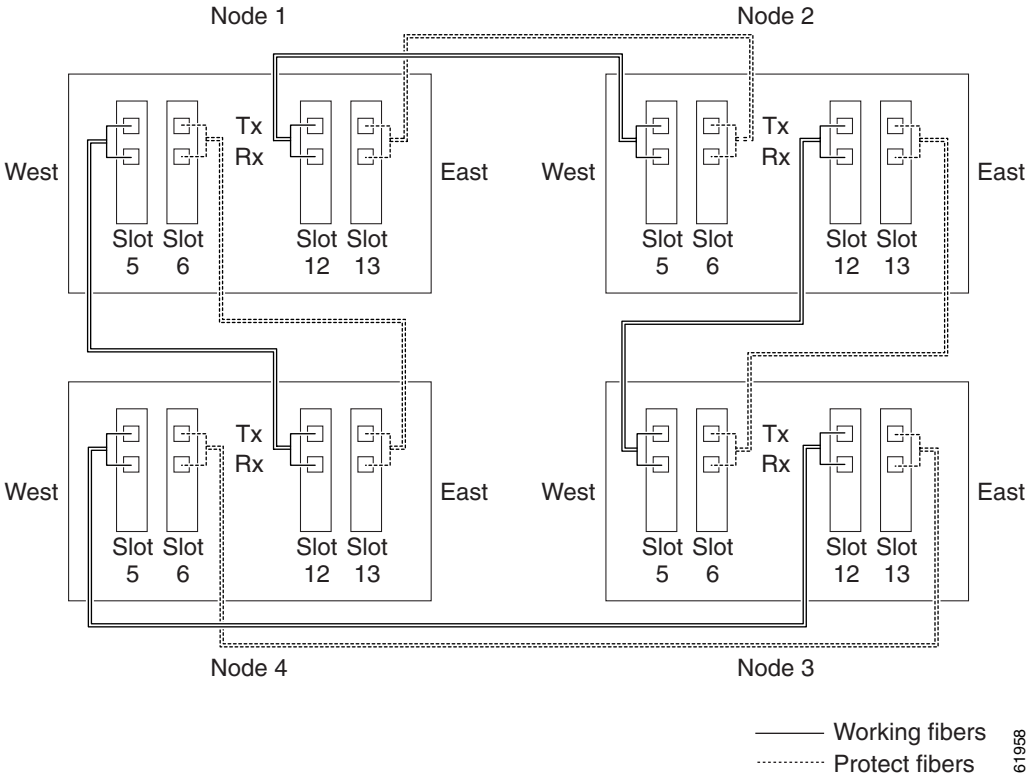
Note Always plug the transmit (Tx) connector of an STM-N card at one node into the receive (Rx) connector of an STM-N card at the adjacent node. Cards display an SF LED when Tx and Rx connections are mismatched.

Figure 12-11 Connecting Fiber to a Four-Node, Two-Fiber MS-SPRing



For four-fiber MS-SPRings, use the same east-west connection pattern for the working and protect fibers. Do not mix working and protect card connections. The MS-SPRing does not function if working and protect cards are interconnected. Figure 12-12 shows fiber connections for a four-fiber MS-SPRing. Slot 5 (west) and Slot 12 (east) carry the working traffic. Slot 6 (west) and Slot 13 (east) carry the protect traffic.

Figure 12-12 Connecting Fiber to a Four-Node, Four-Fiber MS-SPRing



12.2.6 Two-Fiber MS-SPRing to Four-Fiber MS-SPRing Conversion

Two-fiber STM-16 or STM-64 MS-SPRings can be converted to four-fiber MS-SPRings. To convert the MS-SPRing, install two STM-16 or STM-64 cards at each two-fiber MS-SPRing node, then log into CTC and convert each node from two-fiber to four-fiber. The fibers that were divided into working and protect bandwidths for the two-fiber MS-SPRing are now fully allocated for working MS-SPRing traffic. Refer to the *Cisco ONS 15454 SDH Procedure Guide* for MS-SPRing conversion procedures.

12.3 Subnetwork Connection Protection

Subnetwork connection protection (SNCP) rings provide duplicate fiber paths in the network. Working traffic flows in one direction and protection traffic flows in the opposite direction. If a problem occurs in the working traffic path, the receiving node switches to the path coming from the opposite direction. With SNCP ring networks, switching occurs at the end of the path and is triggered by defects or alarms along the path.

The network can be divided into a number of interconnected subnetworks. Within each subnetwork, protection is provided at the path level and the automatic protection switching between two paths is provided at the subnetwork boundaries. The node at the end of the path and the intermediate nodes in the path select the best traffic signal. The virtual container is not terminated at the intermediate node; instead, it compares the quality of the signal on the two incoming ports and selects the better signal.

CTC automates ring configuration. SNCP ring network traffic is defined within the ONS 15454 SDH on a circuit-by-circuit basis. If an extended SNCP ring mesh network circuit is not defined within a 1+1 or MS-SPRing line protection scheme and path protection is available and specified, CTC uses an SNCP ring as the default protection mechanism.

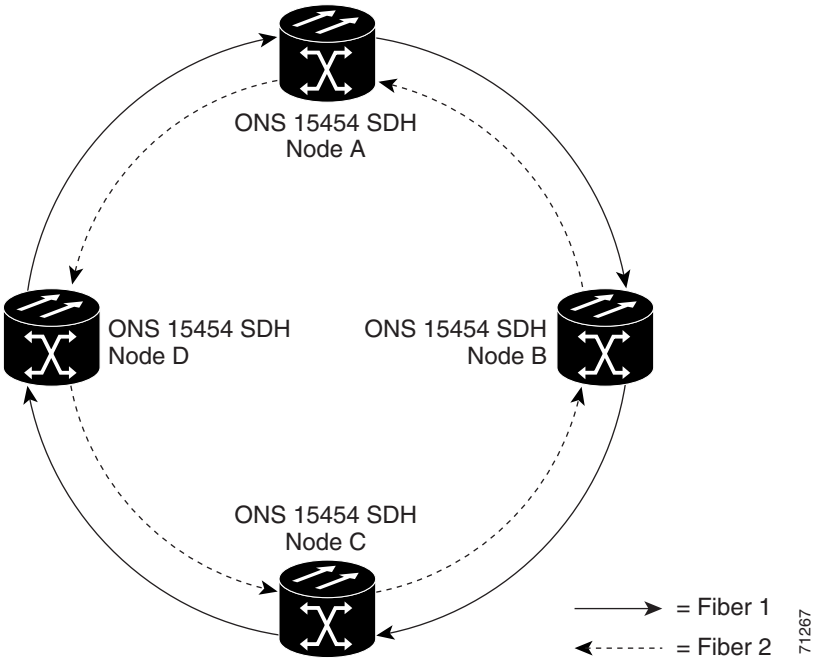
An SNCP ring circuit requires two DCC-provisioned optical spans per node. SNCP ring circuits can be created across these spans until their bandwidth is consumed.

The span bandwidth consumed by an SNCP ring circuit is two times the circuit bandwidth because the circuit is duplicated. The cross-connection bandwidth consumed by an SNCP ring circuit is three times the circuit bandwidth at the source and destination nodes only. The cross-connection bandwidth consumed by an intermediate node has a factor of one.

The SNCP ring circuit limit is the sum of the optical bandwidth containing 84 regenerator-section data communication channels (RS-DCCs) or 28 multiplex-section data communication channels (MS-DCCs), divided by two. The spans can be of any bandwidth from STM-1 to STM-64.

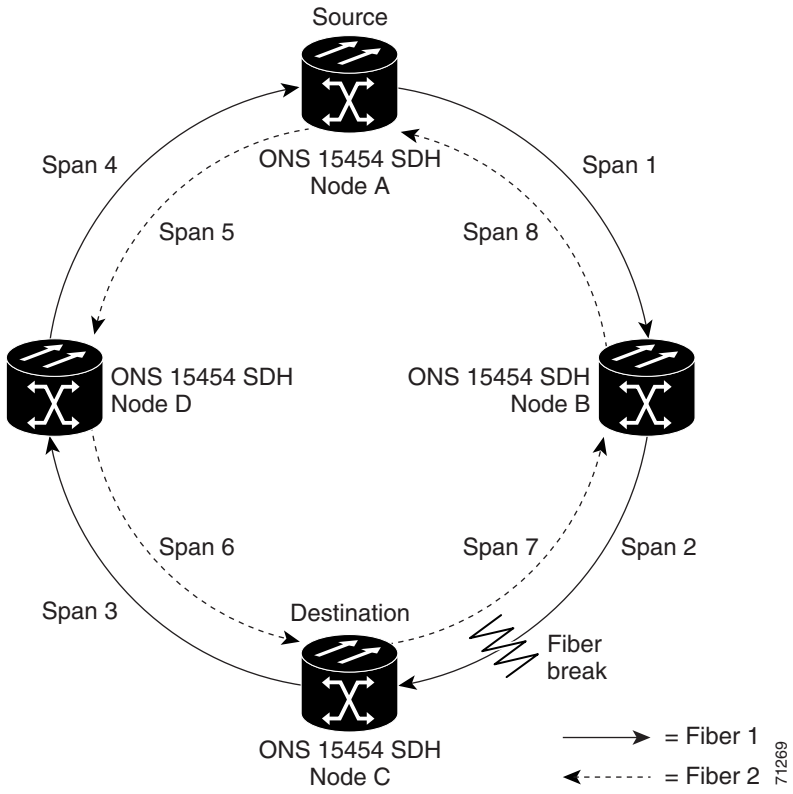
Figure 12-13 shows a basic SNCP ring configuration. If Node A sends a signal to Node C, the working signal travels on the working traffic path through Node B.

Figure 12-13 Basic Four-Node SNCP Ring



The same signal is also sent on the protect traffic path through Node D. If a fiber break occurs (Figure 12-14), Node C switches its active receiver to the protect signal coming through Node D.

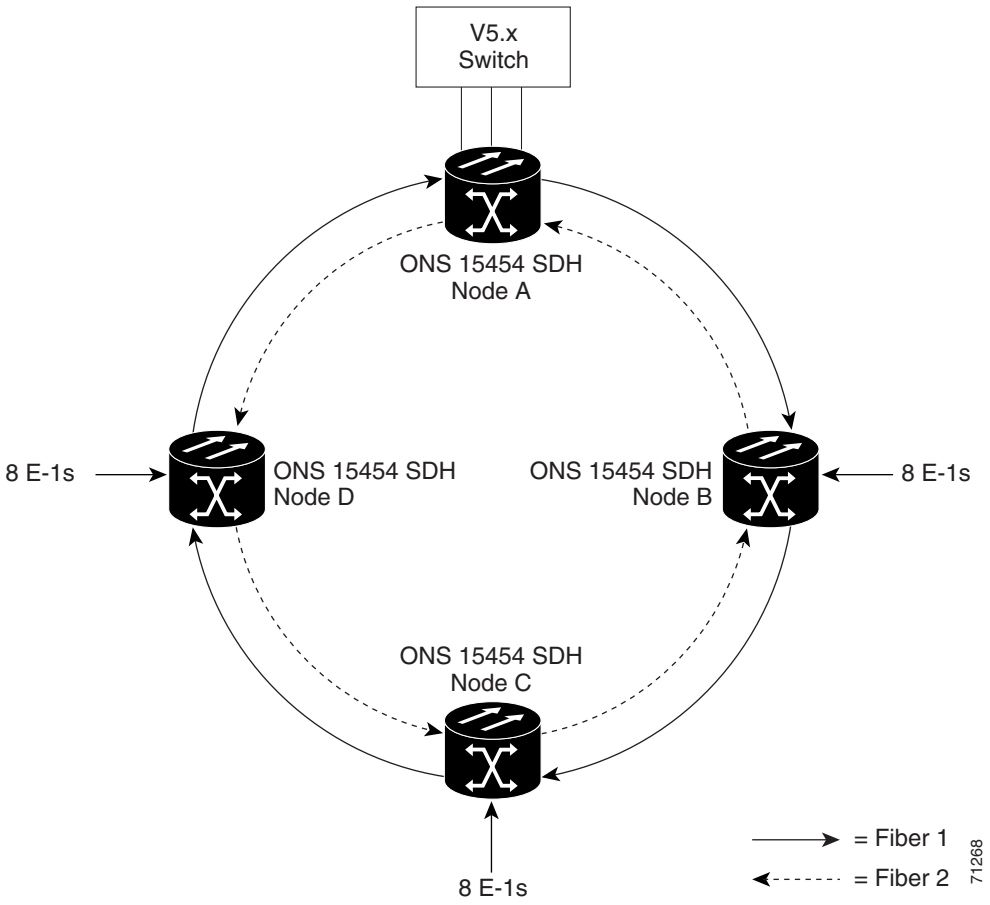
Figure 12-14 SNCP Ring with a Fiber Break



Because each traffic path is transported around the entire ring, SNCP rings are best suited for networks where traffic concentrates at one or two locations and is not widely distributed. SNCP ring capacity is equal to its bit rate. Services can originate and terminate on the same SNCP ring, or they can be passed to an adjacent access or interoffice ring for transport to the service-terminating node.

Figure 12-15 shows a common SNCP ring application. STM-1 path circuits provide remote switch connectivity to a host V5.x switch. In the example, each remote switch requires eight E-1s to return to the host switch. Figure 12-16 on page 12-17 and Figure 12-17 on page 12-17 show the shelf layout for each node in the example.

Figure 12-15 STM-1 SNCP Ring



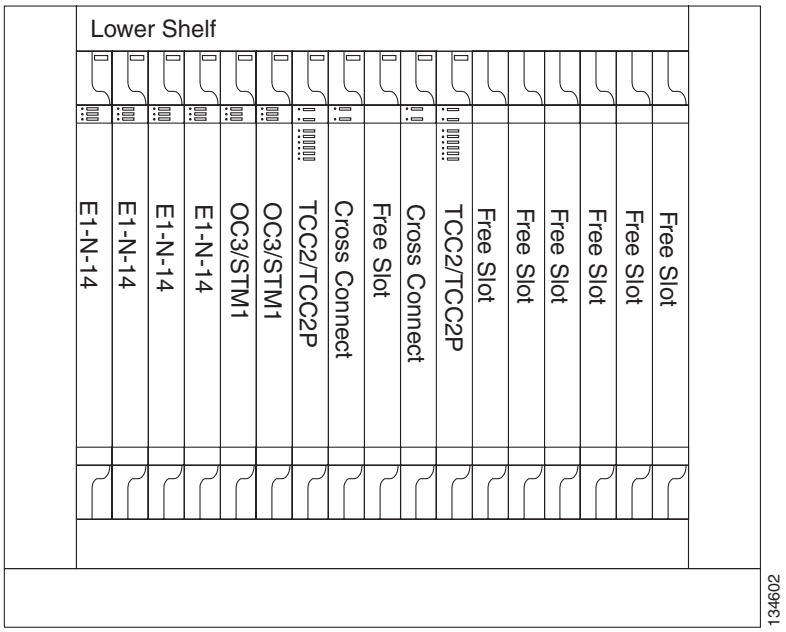
Node A has four E1-14 cards to provide 42 active E-1 ports. The other sites only require two E1-14 cards to carry the eight E-1s to and from the remote switch. You can use the other half of each ONS 15454 SDH shelf assembly to provide support for a second or third ring to other existing or planned remote sites.

In this sample STM-1 SNCP ring, Node A contains four E1-14 cards and two STM-1 cards. Six free slots are available, which you can provision with cards or leave empty.

Caution Fill unused card slots with a filler card (Cisco P/N 15454-BLANK). Cover unused FMEC slots with a blank faceplate (Cisco P/N 15454E-BLANK-FMEC). The filler cards and blank faceplates ensure proper airflow when operating the ONS 15454 SDH without the front door attached, although Cisco recommends that the front door remain attached.

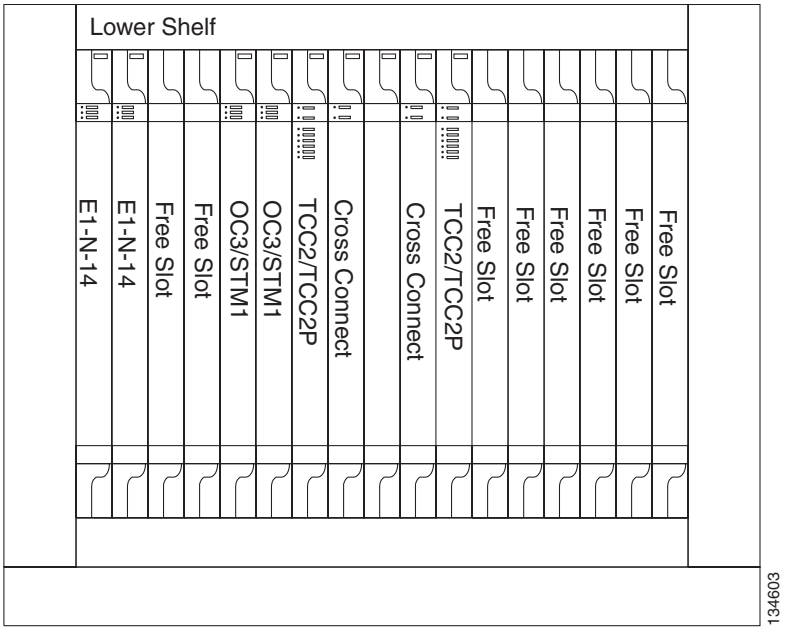
Figure 12-16 shows the shelf setup for this sample configuration.

Figure 12-16 Card Setup of Node A in the STM-1 SNCP Ring Example



In Figure 12-15 on page 12-16, Nodes B through D each contain two E1-14 cards and two STM-1 cards. Eight free slots are available that you can provision with other cards or leave empty. Figure 12-17 shows the shelf assembly setup for this sample configuration.

Figure 12-17 Card Setup of Nodes B-D in the STM-1 SNCP Ring Example



12.4 Dual Ring Interconnect

Dual ring interconnect (DRI) topology provides an extra level of path protection for circuits on interconnected rings. DRI allows users to interconnect MS-SPRings, SNCPs, or an SNCP with an MS-SPRing, with additional protection provided at the transition nodes. In a DRI topology, ring interconnections occur at two or four nodes.

The drop-and-continue DRI method is used for all ONS 15454 SDH DRIs. In drop-and-continue DRI, a primary node drops the traffic to the connected ring and routes traffic to a secondary node within the same ring. The secondary node also routes the traffic to the connected ring; that is, the traffic is dropped at two different interconnection nodes to eliminate single points of failure. To route circuits on DRI, you must choose the Dual Ring Interconnect option during circuit provisioning. Dual transmit is not supported.

Two DRI topologies can be implemented on the ONS 15454 SDH:

- A traditional DRI requires two pairs of nodes to interconnect two networks. Each pair of user-defined primary and secondary nodes drops traffic over a pair of interconnection links to the other network.
- An integrated DRI requires one pair of nodes to interconnect two networks. The two interconnected nodes replace the interconnection ring.

For DRI topologies, a hold-off timer sets the amount of time before a selector switch occurs. It reduces the likelihood of multiple switches, such as:

- Both a service selector and a path selector
- Both a line switch and a path switch of a service selector

For example, if an SNCP DRI service selector switch does not restore traffic, then the path selector switches after the hold-off time. The SNCP DRI hold-off timer default is 100 ms. You can change this setting in the SNCP Selectors tab of the Edit Circuits window. For MS-SPRing DRI, if line switching does not restore traffic, then the service selector switches. The hold-off time delays the recovery provided by the service selector. The MS-SPRing DRI default hold-off time is 100 ms, but it can be changed.

12.4.1 MS-SPRing DRI

Unlike MS-SPRing automatic protection switching (APS) protocol, MS-SPRing DRI is a path-level protection protocol at the circuit level. Drop-and-continue MS-SPRing DRI requires a service selector in the primary node for each circuit routing to the other ring. Service selectors monitor signal conditions from dual feed sources and select the one that has the best signal quality. Same-side routing drops the traffic at primary nodes set up on the same side of the connected rings, and opposite-side routing drops the traffic at primary nodes set up on the opposite sides of the connected rings. For MS-SPRing DRI, primary and secondary nodes cannot be the circuit source or destination.

Note A DRI circuit cannot be created if an intermediate node exists on the interconnecting link. However, an intermediate node can be added on the interconnecting link after the DRI circuit is created.

DRI protection circuits act as protection channel access (PCA) circuits. In CTC, you set up DRI protection circuits by selecting the PCA option when setting up primary and secondary nodes during DRI circuit creation.

Figure 12-18 shows ONS 15454 SDH nodes in a traditional MS-SPRing DRI topology with same-side routing. In Ring 1, Nodes 3 and 4 are the interconnect nodes, and in Ring 2, Nodes 8 and 9 are the interconnect nodes. Duplicate signals are sent between Node 4 (Ring 1) and Node 9 (Ring 2), and between Node 3 (Ring 1) and Node 8 (Ring 2). The primary nodes (Nodes 4 and 9) are on the same side, and the secondary nodes (Nodes 3 and 8) provide an alternative route. In Ring 1, traffic at Node 4 is dropped (to Node 9) and continued (to Node 10). Similarly, at Node 9, traffic is dropped (to Node 4) and continued (to Node 5).

Figure 12-18 ONS 15454 SDH Traditional MS-SPRing Dual Ring Interconnect (Same-Side Routing)

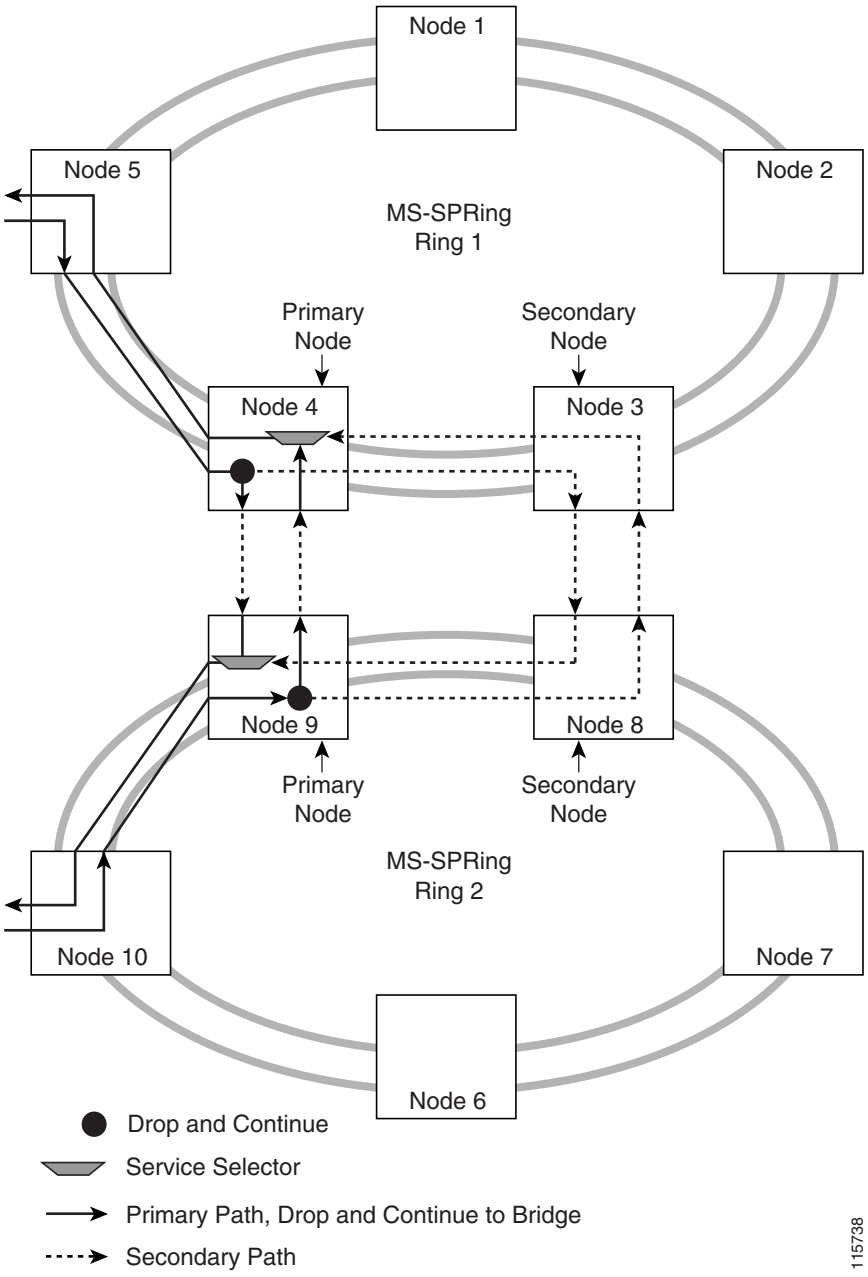


Figure 12-19 shows ONS 15454 SDH nodes in a traditional MS-SPRing DRI topology with opposite-side routing. In Ring 1, Nodes 3 and 4 are the interconnect nodes, and in Ring 2, Nodes 8 and 9 are the interconnect nodes. Duplicate signals are sent from Node 4 (Ring 1) to Node 8 (Ring 2), and between Node 3 (Ring 1) and Node 9 (Ring 2). In Ring 1, traffic at Node 4 is dropped (to Node 9) and continued (to Node 8). Similarly, at Node 8, traffic is dropped (to Node 3) and continued (to Node 4).

Figure 12-19 ONS 15454 SDH Traditional MS-SPRing Dual Ring Interconnect (Opposite-Side Routing)

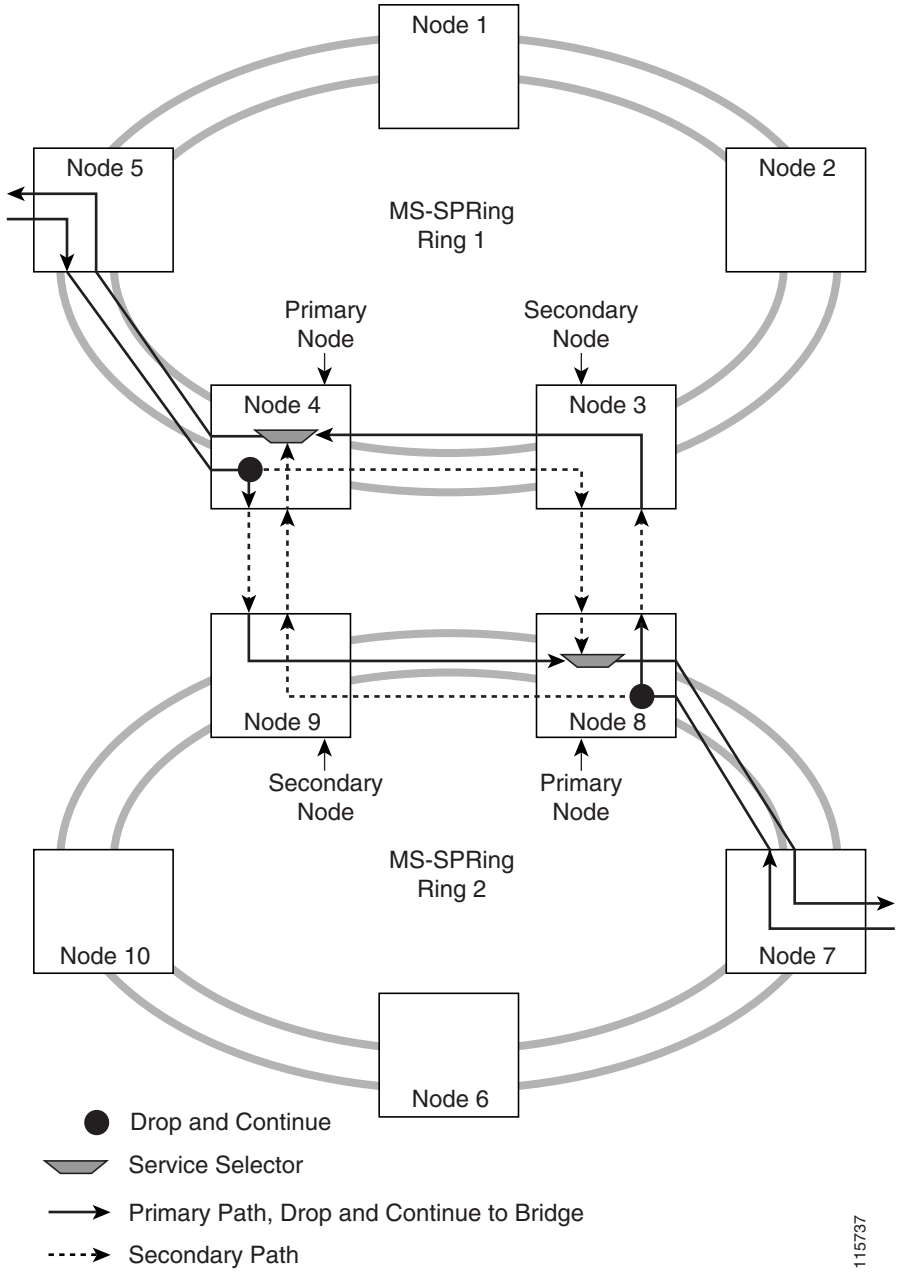
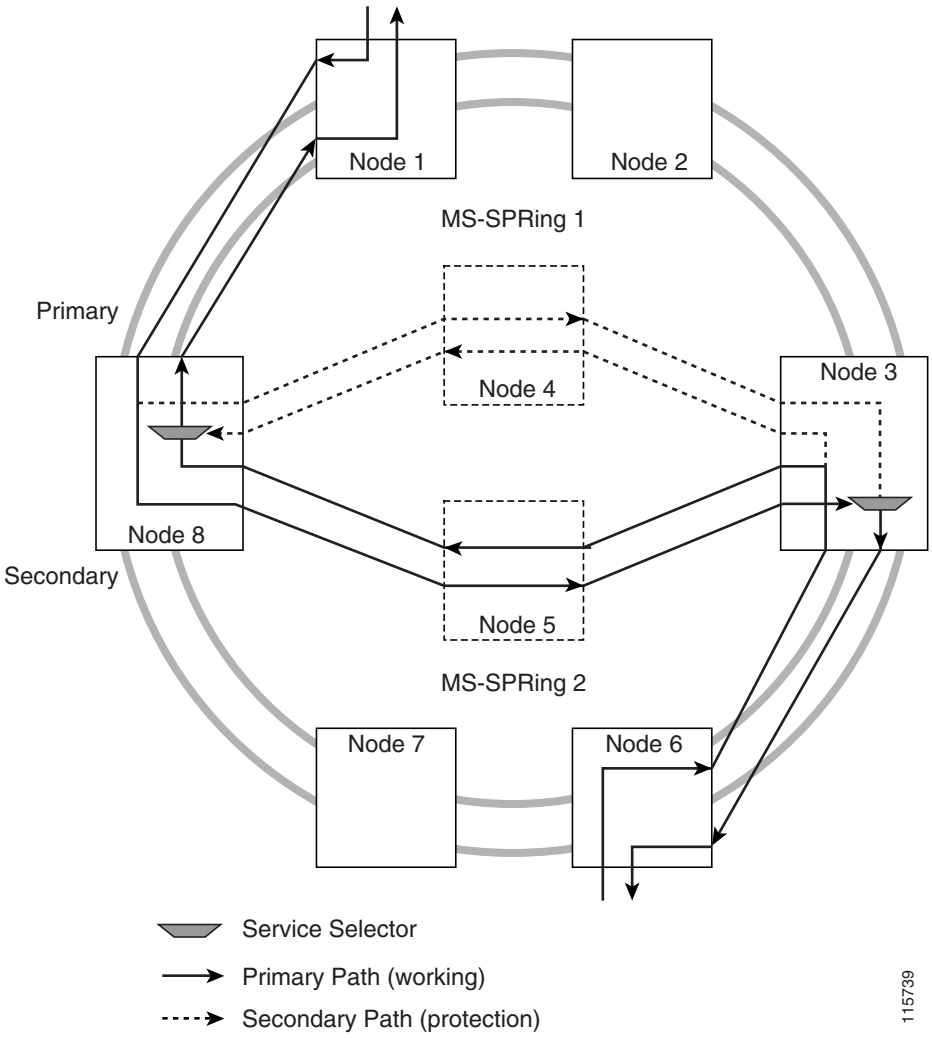


Figure 12-20 shows ONS 15454 SDH nodes in an integrated MS-SPRing DRI topology. The same drop-and-continue traffic routing occurs at two nodes, rather than four. This is achieved by installing an additional STM-N trunk at the two interconnect nodes. Nodes 3 and 8 are the interconnect nodes.

Figure 12-20 ONS 15454 SDH Integrated MS-SPRing Dual Ring Interconnect



12.4.2 SNCP Dual Ring Interconnect

The SNCP dual ring interconnect topology (SNCP DRI) provides an extra level of path protection between interconnected SNCP rings. In DRIs, traffic is dropped and continued at the interconnecting nodes to eliminate single points of failure. Two DRI topologies can be implemented on the ONS 15454 SDH. The traditional DRI uses four ONS 15454 SDH nodes at the interconnect nodes, while the integrated DRI uses two nodes.

Figure 12-21 shows ONS 15454 SDH nodes in a traditional DRI topology. In Ring 1, Nodes 4 and 5 are the interconnect nodes, and in Ring 2, Nodes 6 and 7 are the interconnect nodes. Duplicate signals are sent from Node 4 (Ring 1) to Node 6 (Ring 2), and between Node 5 (Ring 1) and Node 7 (Ring 2). In Ring 1, traffic at Node 4 is dropped (to Node 6) and continued (to Node 5). Similarly, at Node 5, traffic is dropped (to Node 7) and continued (to Node 4).

To route circuits on the DRI, you must choose the DRI option during circuit provisioning. Circuits with the DRI option enabled are routed on the DRI path.

Figure 12-21 ONS 15454 Traditional SDH Dual Ring Interconnect

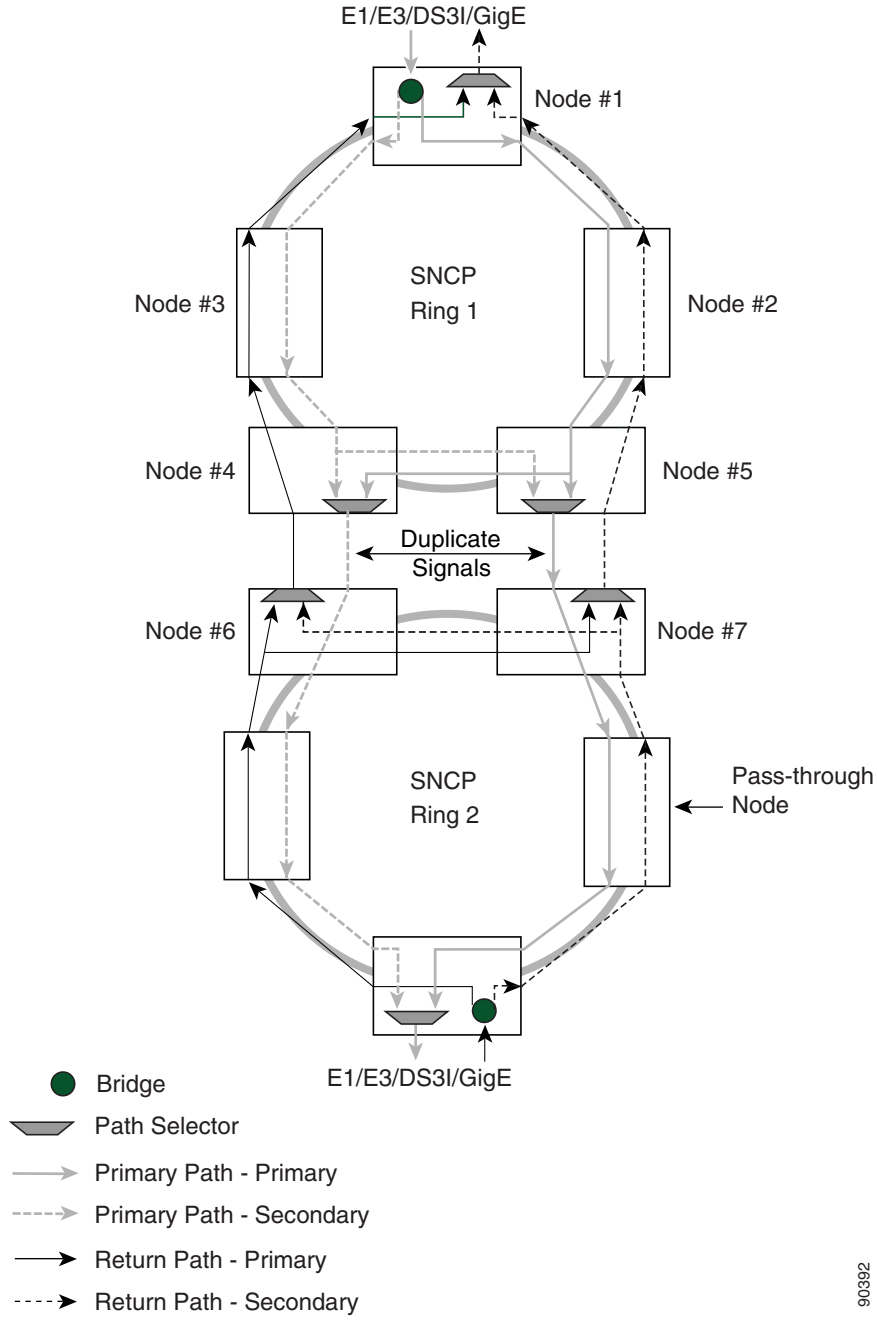
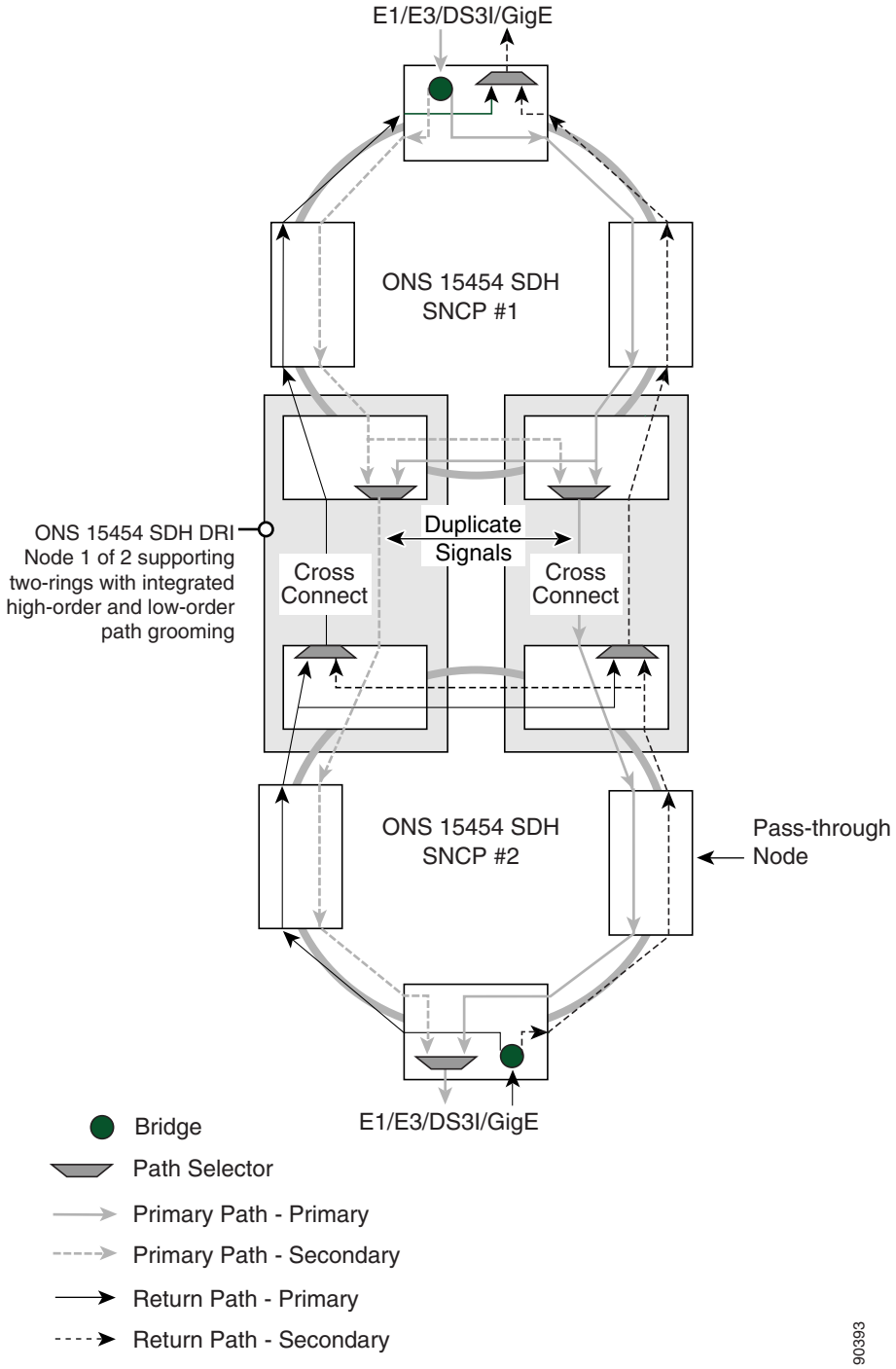


Figure 12-22 shows ONS 15454 SDH nodes in an integrated DRI topology. The same drop and continue traffic routing occurs at two nodes, rather than four. This is achieved by installing an additional STM-N trunk at the two interconnect nodes.

Figure 12-22 ONS 15454 SDH Integrated Dual Ring Interconnect



12.4.3 SNCP/MS-SPRing DRI Handoff Configurations

SNCPs and MS-SPRings can also be interconnected. In SNCP/MS-SPRing DRI handoff configurations, primary and secondary nodes can be the circuit source or destination, which is useful when non-DCC optical interconnecting links are present. Figure 12-23 shows an example of an SNCP to MS-SPRing traditional DRI handoff.

Figure 12-23 ONS 15454 SDH SNCP to MS-SPRing Traditional DRI Handoff

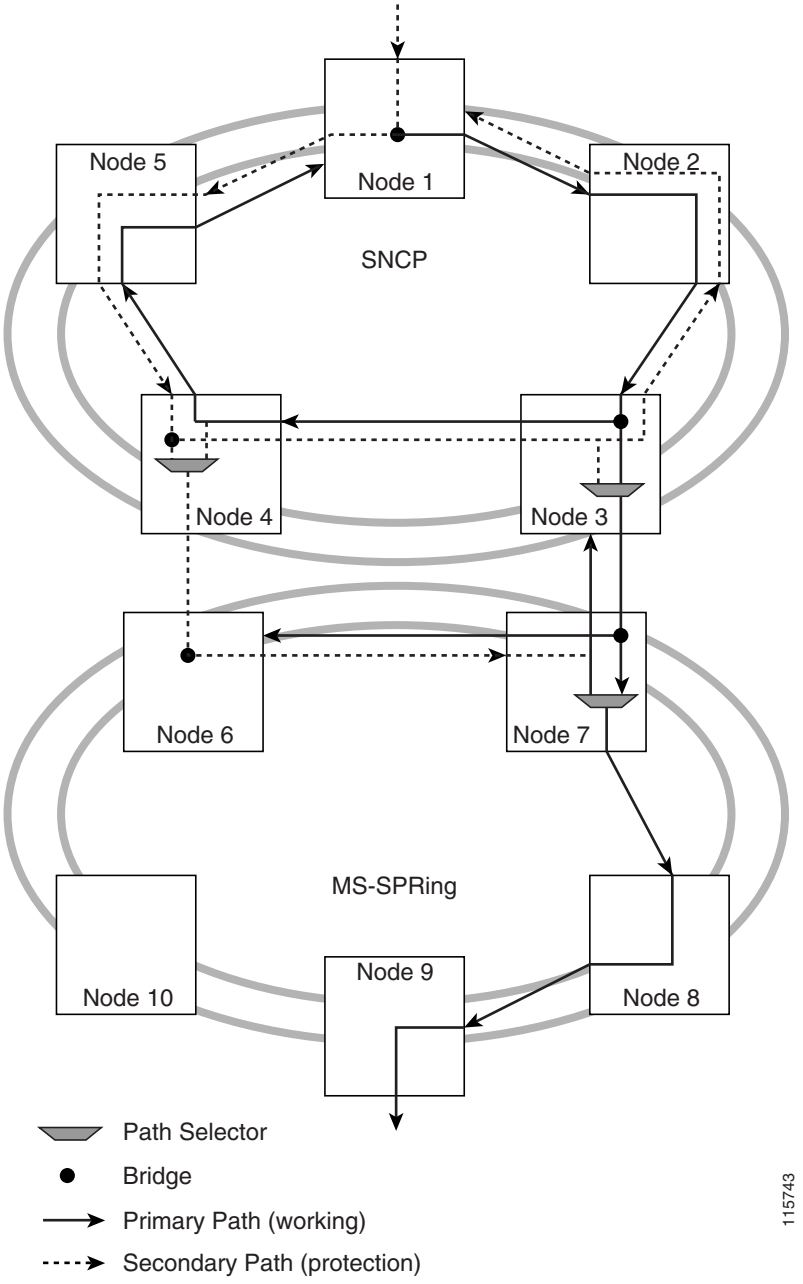
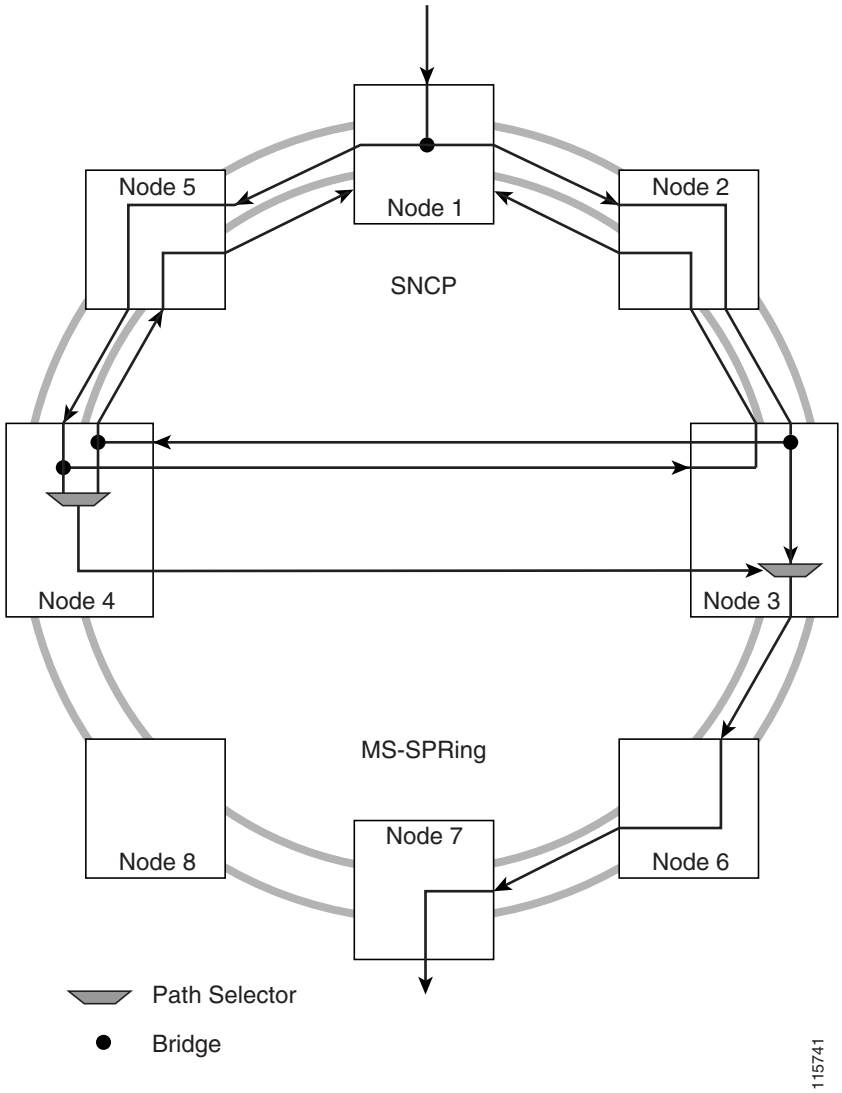


Figure 12-24 shows an example of an SNCP to MS-SPRing integrated DRI handoff.

Figure 12-24 ONS 15454 SDH SNCP to MS-SPRing Integrated DRI Handoff



12.5 Subtending Rings

The ONS 15454 SDH supports up to 84 SDH regenerator RS-DCCs or 28 MS-DCCs with TCC2/TCC2P cards. See Table 12-1 on page 12-1 for ring and regenerator RS-DCC and MS-DCC information.

Subtending rings reduce the number of nodes and cards required and reduce external shelf-to-shelf cabling. Figure 12-25 shows an ONS 15454 SDH with multiple subtending rings.

Figure 12-25 ONS 15454 SDH with Multiple Subtending Rings

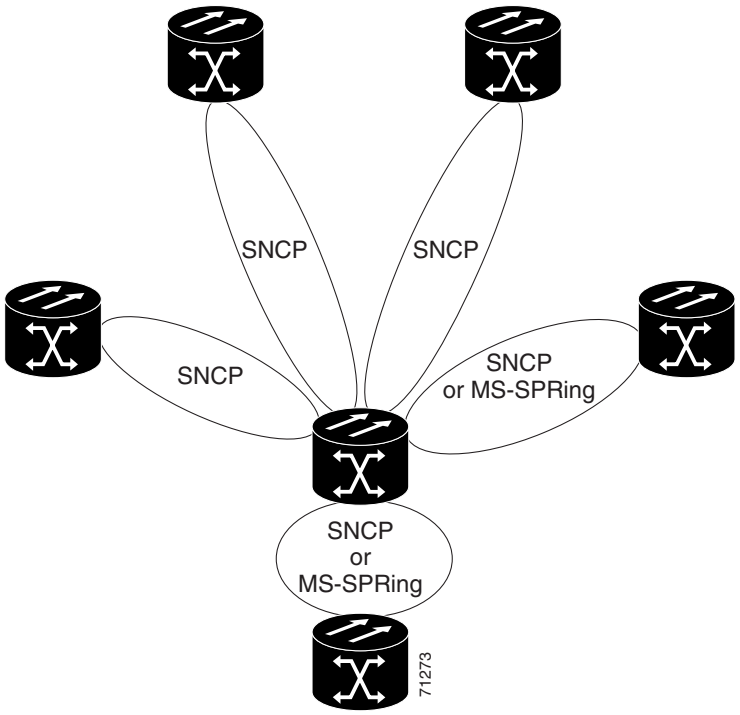
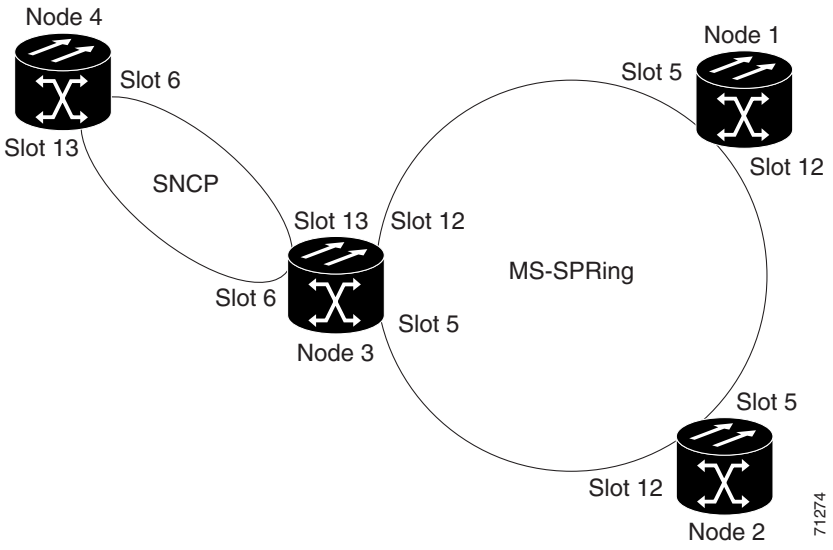


Figure 12-26 shows an SNCP ring subtending from an MS-SPRing. In this example, Node 3 is the only node serving both the MS-SPRing and SNCP ring. STM-N cards in Slots 5 and 12 serve the MS-SPRing, and STM-N cards in Slots 6 and 13 serve the SNCP ring.

Figure 12-26 SNCP Ring Subtending from an MS-SPRing

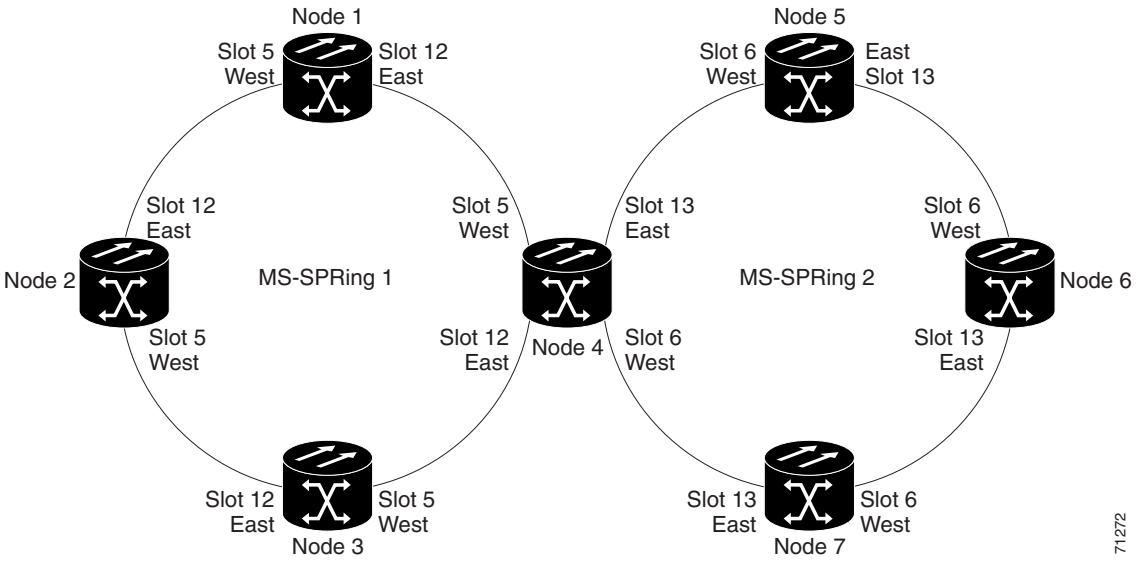


The ONS 15454 SDH can support five MS-SPRings on the same node. This allows you to deploy an ONS 15454 SDH in applications requiring SDH Digital Cross-connect Systems (DCSs) or multiple SDH add/drop multiplexers (ADMs).

Figure 12-27 shows two MS-SPRings shared by one ONS 15454 SDH. Ring 1 runs on Nodes 1, 2, 3, and 4. Ring 2 runs on Nodes 4, 5, 6, and 7. Two MS-SPRing, Ring 1 and Ring 2, are provisioned on Node 4. Ring 1 uses cards in Slots 5 and 12, and Ring 2 uses cards in Slots 6 and 13.

Note Nodes in different MS-SPRings can have the same or different node IDs.

Figure 12-27 MS-SPRing Subtending from an MS-SPRing



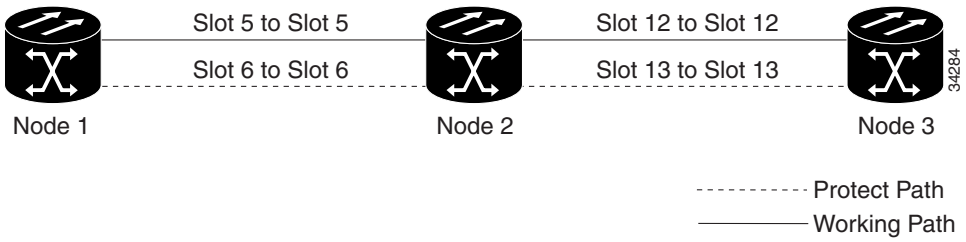
After subtending two MS-SPRings, you can route circuits from nodes in one ring to nodes in the second ring. For example, in Figure 12-27 you can route a circuit from Node 1 to Node 7. The circuit would normally travel from Node 1 to Node 4 to Node 7. If fiber breaks occur, for example between Nodes 1 and 4 and Nodes 4 and 7, traffic is rerouted around each ring: in this example, Nodes 2 and 3 in Ring 1 and Nodes 5 and 6 in Ring 2.

12.6 Linear ADM Configurations

You can configure ONS 15454 SDH nodes as a line of add/drop multiplexers (ADMs) by configuring one set of STM-N cards as the working path and a second set as the protect path. Unlike rings, linear (point-to-point) ADMs require that the STM-N cards at each node be in 1+1 protection to ensure that a break to the working line is automatically routed to the protect line.

Figure 12-28 shows three ONS 15454 SDH nodes in a linear ADM configuration. Working traffic flows from Node 1/Slot 5 to Node 2/Slot 5, and from Node 2/Slot 12 to Node 3/Slot 12. You create the protect path by placing Slot 6 in 1+1 protection with Slot 5 at Nodes 1 and 2, and placing Slot 12 in 1+1 protection with Slot 13 at Nodes 2 and 3.

Figure 12-28 Linear (Point-to-Point) ADM Configuration



12.7 Extended SNCP Mesh Networks

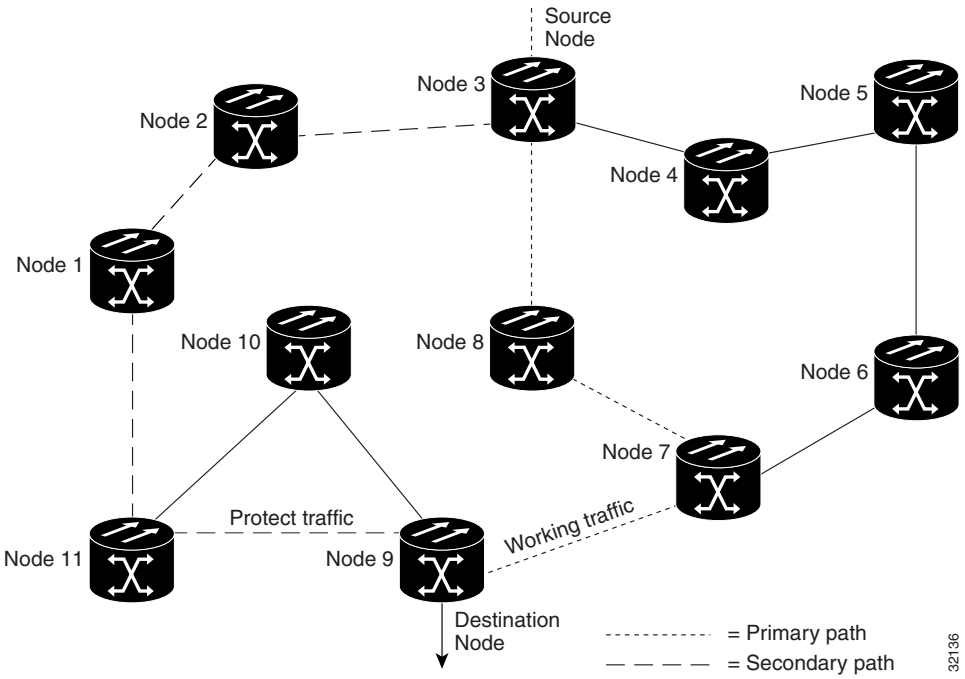
In addition to single MS-SPRings, SNCP rings, and ADMs, you can extend ONS 15454 SDH traffic protection by creating extended SNCP mesh networks. Extended SNCP rings include multiple ONS 15454 SDH topologies and extend the protection provided by a single SNCP ring to the meshed architecture of several interconnecting rings.

In an extended SNCP ring, circuits travel diverse paths through a network of single or multiple meshed rings. When you create circuits, you can provision CTC to automatically route circuits across the Extended SNCP ring, or you can manually route them. You can also choose levels of circuit protection. For example, if you choose full protection, CTC creates an alternate route for the circuit in addition to the main route. The second route follows a unique path through the network between the source and destination and sets up a second set of cross-connections.

For example, in Figure 12-29, a circuit is created from Node 3 to Node 9. CTC determines that the shortest route between the two nodes passes through Node 8 and Node 7, shown by the dotted line, and automatically creates cross-connections at Nodes, 3, 8, 7, and 9 to provide the primary circuit path.

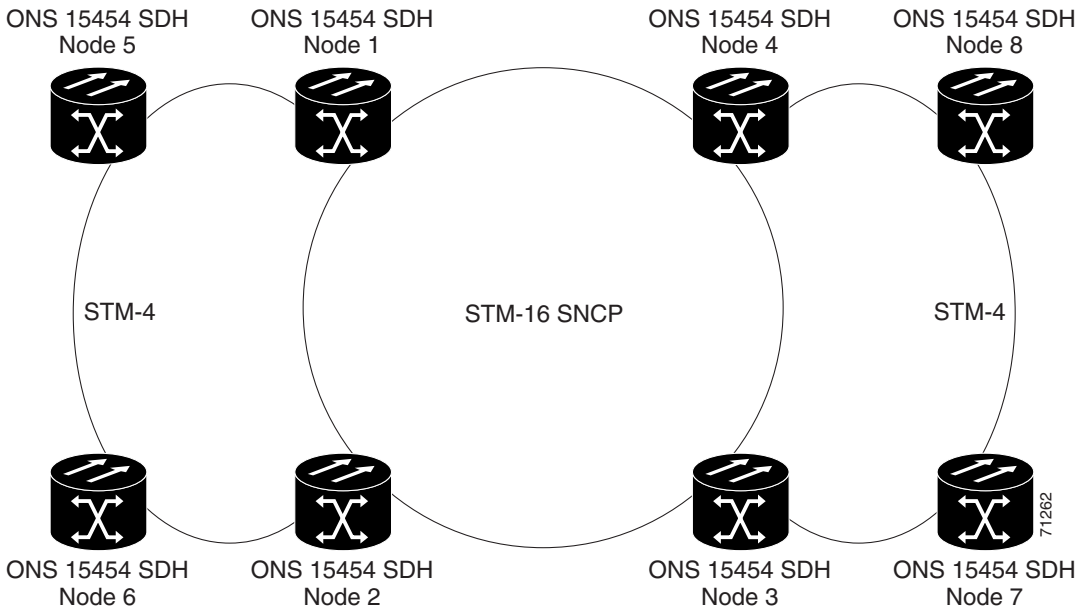
If full protection is selected, CTC creates a second unique route between Nodes 3 and 9 which, in this example, passes through Nodes 2, 1, and 11. Cross-connections are automatically created at Nodes 3, 2, 1, 11, and 9, shown by the dashed line. If a failure occurs on the primary path, traffic switches to the second circuit path. In this example, Node 9 switches from the traffic coming in from Node 7 to the traffic coming in from Node 11 and service resumes. The switch occurs within 50 ms.

Figure 12-29 Extended SNCP Mesh Network



Extended SNCP rings also allow spans with different SDH speeds to be mixed together in "virtual rings." Figure 12-30 shows Nodes 1, 2, 3, and 4 in a standard STM-16 ring. Nodes 5, 6, 7, and 8 link to the backbone ring through STM-4 fiber. The "virtual ring" formed by Nodes 5, 6, 7, and 8 uses both STM-16 and STM-4 cards.

Figure 12-30 Extended SNCP Virtual Ring



12.8 Four Node Configurations

You can link multiple ONS 15454 SDH nodes using their STM-N cards (that is, create a fiber-optic bus) to accommodate more access traffic than a single ONS 15454 SDH can support. Refer to the *Cisco ONS 15454 SDH Procedure Guide* for more information. You can link nodes with STM-4 or STM-16 fiber spans as you would link any other two network nodes. The nodes can be grouped in one facility to aggregate more local traffic. Each shelf assembly is recognized as a separate node in the ONS 15454 SDH software interface and traffic is mapped using CTC cross-connect options.

12.9 STM-N Speed Upgrades

A span is the optical fiber connection between two ONS 15454 SDH nodes. In a span (optical speed) upgrade, the transmission rate of a span is upgraded from a lower to a higher STM-N signal but all other span configuration attributes remain unchanged. With multiple nodes, a span upgrade is a coordinated series of upgrades on all nodes in the ring or protection group. You can perform in-service span upgrades for the following ONS 15454 SDH cards:

- Single-port STM-4 to STM-16
- Single-port STM-4 to STM-64
- Single-port STM-4 to MRC-12
- STM-16 to STM-64

You can also perform in-service card upgrades for the following ONS 15454 SDH cards:

- Four-port STM-1 to eight-port STM-1
- Single-port STM-4 to four-port STM-4
- STM-16 to MRC-12
- STM-64 to STM64-XFP

Note Since the four-port STM-1 to eight-port STM-1 cards and the single-port STM-4 to four-port STM-4 cards are the same speed, they are not considered span upgrades.

To perform a span upgrade, the higher-rate optical card must replace the lower-rate card in the same slot. If the upgrade is conducted on spans residing in an MS-SPRing, all spans in the ring must be upgraded. The protection configuration of the original lower-rate optical card (two-fiber MS-SPRing, four-fiber MS-SPRing, SNCP ring, and 1+1) is retained for the higher-rate STM-N card.

To perform a span upgrade on either the STM64-XFP or MRC-12 card with an SFP/XFP (known as pluggable port modules [PPMs] in CTC), the higher-rate PPM must replace the lower-rate PPM in the same slot. If you are using a multirate PPM, you do not need to physically replace the PPM but can provision the PPM for a different line rate. All spans in the network must be upgraded. The 1+1 protection configuration of the original lower-rate PPM is retained for the higher-rate PPM.

When performing span upgrades on a large number of nodes, Cisco recommends that you upgrade all spans in a ring consecutively and in the same maintenance window. Until all spans are upgraded, mismatched card types or PPM types are present.

We recommend using the Span Upgrade Wizard to perform span upgrades. Although you can also use the manual span upgrade procedures, the manual procedures are mainly provided as error recovery for the wizard. The Span Upgrade Wizard and the Manual Span Upgrade procedures require at least two

technicians (one at each end of the span) who can communicate with each other during the upgrade. Upgrading a span is non-service affecting and causes no more than three switches, each of which is less than 50 ms in duration.

Note Span upgrades do not upgrade SDH topologies, for example, a 1+1 group to a two-fiber MS-SPRing. Refer to the *Cisco ONS 15454 SDH Procedure Guide* for topology upgrade procedures.

12.9.1 Span Upgrade Wizard

The Span Upgrade Wizard automates all steps in the manual span upgrade procedure (MS-SPRing, SNCP ring, and 1+1). The wizard can upgrade both lines on one side of a four-fiber MS-SPRing or both lines of a 1+1 group; the wizard upgrades SNCP rings and two-fiber MS-SPRings one line at a time. The Span Upgrade Wizard requires that spans have DCCs enabled.

The Span Upgrade Wizard provides no way to back out of an upgrade. In the case of an error, you must exit the wizard and initiate the manual procedure to either continue with the upgrade or back out of it. To continue with the manual procedure, examine the standing conditions and alarms to identify the stage in which the wizard failure occurred.

12.9.2 Manual Span Upgrades

Manual Span Upgrades are mainly provided as error recovery for the Span Upgrade Wizard, but they can be used to perform span upgrades. Downgrading can be performed to back out of a span upgrade. The procedure for downgrading is the same as upgrading except that you choose a lower-rate card type. You cannot downgrade if circuits exist on the VCs that will be removed (the higher VCs).

Procedures for manual span upgrades can be found in the "Upgrade Cards and Spans" chapter in the *Cisco ONS 15454 SDH Procedure Guide.* Five manual span upgrade options are available:

- Upgrade on a two-fiber MS-SPRing
- Upgrade on a four-fiber MS-SPRing
- Upgrade on an SNCP ring
- Upgrade on a 1+1 protection group
- Upgrade on an unprotected span

CHAPTER 13

Management Network Connectivity

This chapter provides an overview of ONS 15454 SDH data communications network (DCN) connectivity. Cisco Optical Networking System (ONS) network communication is based on IP, including communication between Cisco Transport Controller (CTC) computers and ONS 15454 SDH nodes and communication among networked ONS 15454 SDH nodes. The chapter provides scenarios showing Cisco ONS 15454 SDH nodes in common IP network configurations as well as information about provisionable patchcords, the IP routing table, external firewalls, and open gateway network element (GNE) networks.

Note This chapter does not provide a comprehensive explanation of IP networking concepts and procedures, nor does it provide IP addressing examples to meet all networked scenarios. For ONS 15454 SDH networking setup instructions, refer to the "Turn Up a Node" chapter of the *Cisco ONS 15454 SDH Procedure Guide*.

Although ONS 15454 SDH DCN communication is based on IP, ONS 15454 SDH nodes can be networked to equipment that is based on the Open System Interconnection (OSI) protocol suites. This chapter describes the ONS 15454 SDH OSI implementation and provides scenarios that show how ONS 15454 SDH can be networked within a mixed IP and OSI environment.

Chapter topics include:

- 13.1 IP Networking Overview, page 13-2
- 13.2 IP Addressing Scenarios, page 13-2
- 13.3 Provisionable Patchcords, page 13-22
- 13.4 Routing Table, page 13-24
- 13.5 External Firewalls, page 13-26
- 13.6 Open GNE, page 13-27
- 13.7 TCP/IP and OSI Networking, page 13-30

Note To connect ONS 15454 SDH nodes to an IP network, you must work with a LAN administrator or other individual at your site who has IP networking training and experience.

13.1 IP Networking Overview

ONS 15454 SDH nodes can be connected in many different ways within an IP environment:

- They can be connected to LANs through direct connections or a router.
- IP subnetting subnetting can create multiple logical ONS 15454 networks within a single Class A, B, or C IP network. If you do not subnet, you will only be able to use one network from your Class A, B, or C network.
- Different IP functions and protocols can be used to achieve specific network goals. For example, Proxy Address Resolution Protocol (ARP) enables one LAN-connected ONS 15454 SDH to serve as a gateway for ONS 15454 SDH nodes that are not connected to the LAN.
- Static routes can be created to enable connections among multiple Cisco Transport Controller (CTC) sessions with ONS 15454 SDH nodes that reside on the same subnet.
- ONS 15454 SDH nodes can be connected to Open Shortest Path First (OSPF) networks so ONS 15454 SDH network information is automatically communicated across multiple LANs and WANs.
- The ONS 15454 SDH proxy server can control the visibility and accessibility between CTC computers and ONS 15454 SDH element nodes.

13.2 IP Addressing Scenarios

ONS 15454 SDH IP addressing generally has eight common scenarios or configurations. Use the scenarios as building blocks for more complex network configurations. Table 13-1 provides a general list of items to check when setting up ONS 15454 SDH nodes in IP networks.

Table 13-1 General ONS 15454 SDH IP Troubleshooting Checklist

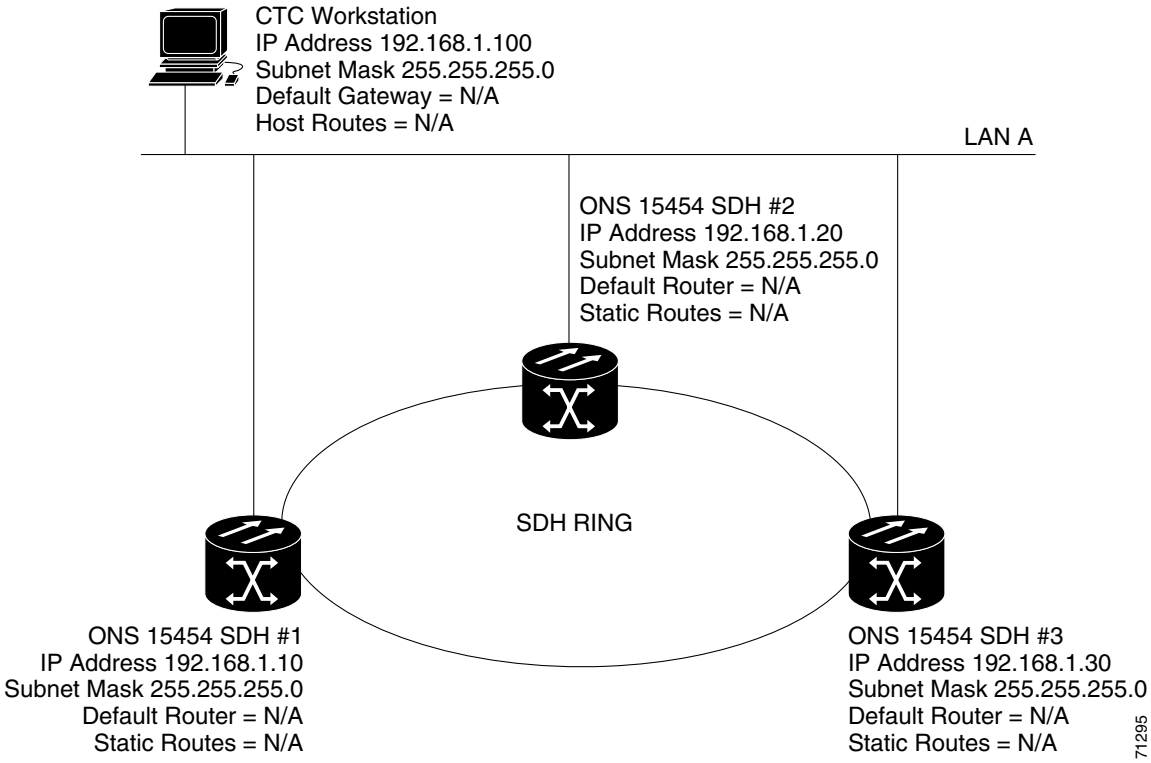
Item	What to check
Link integrity	Verify that link integrity exists between: • CTC computer and network hub/switch • ONS 15454 SDH nodes (MIC-C/T/P wire-wrap pins or RJ-45 port) and network hub/switch • Router ports and hub/switch ports
ONS 15454 SDH hub/switch ports	If connectivity problems occur, set the hub or switch port that is connected to the ONS 15454 SDH to 10 Mbps half-duplex.
Ping	Ping the node to test connections between computers and ONS 15454 SDH nodes.
IP addresses/subnet masks	Verify that ONS 15454 SDH IP addresses and subnet masks are set up correctly.
Optical connectivity	Verify that ONS 15454 SDH optical trunk (span) ports are in service and that a DCC is enabled on each trunk port.

Note The ONS 15454 secure mode option is available when TCC2P cards are installed. Secure mode allows two IP addresses to be provisioned for the node, one for the MIC-C/T/P LAN port and one for the TCC2P DCC interfaces. Secure mode IP addressing is described in the "13.2.9 Scenario 9: IP Addressing with Secure Mode Enabled" section on page 13-20. IP addresses shown in the other scenarios assume secure mode is not enabled or, if enabled, the IP addresses shown in the examples apply to the MIC-C/T/P LAN port.

13.2.1 Scenario 1: CTC and ONS 15454 SDH Nodes on Same Subnet

Scenario 1 shows a basic ONS 15454 SDH LAN configuration (Figure 13-1). The ONS 15454 SDH nodes and CTC computer reside on the same subnet. All ONS 15454 SDH nodes connect to LAN A and all ONS 15454 SDH nodes have DCC connections.

Figure 13-1 Scenario 1: CTC and ONS 15454 SDH Nodes on the Same Subnet

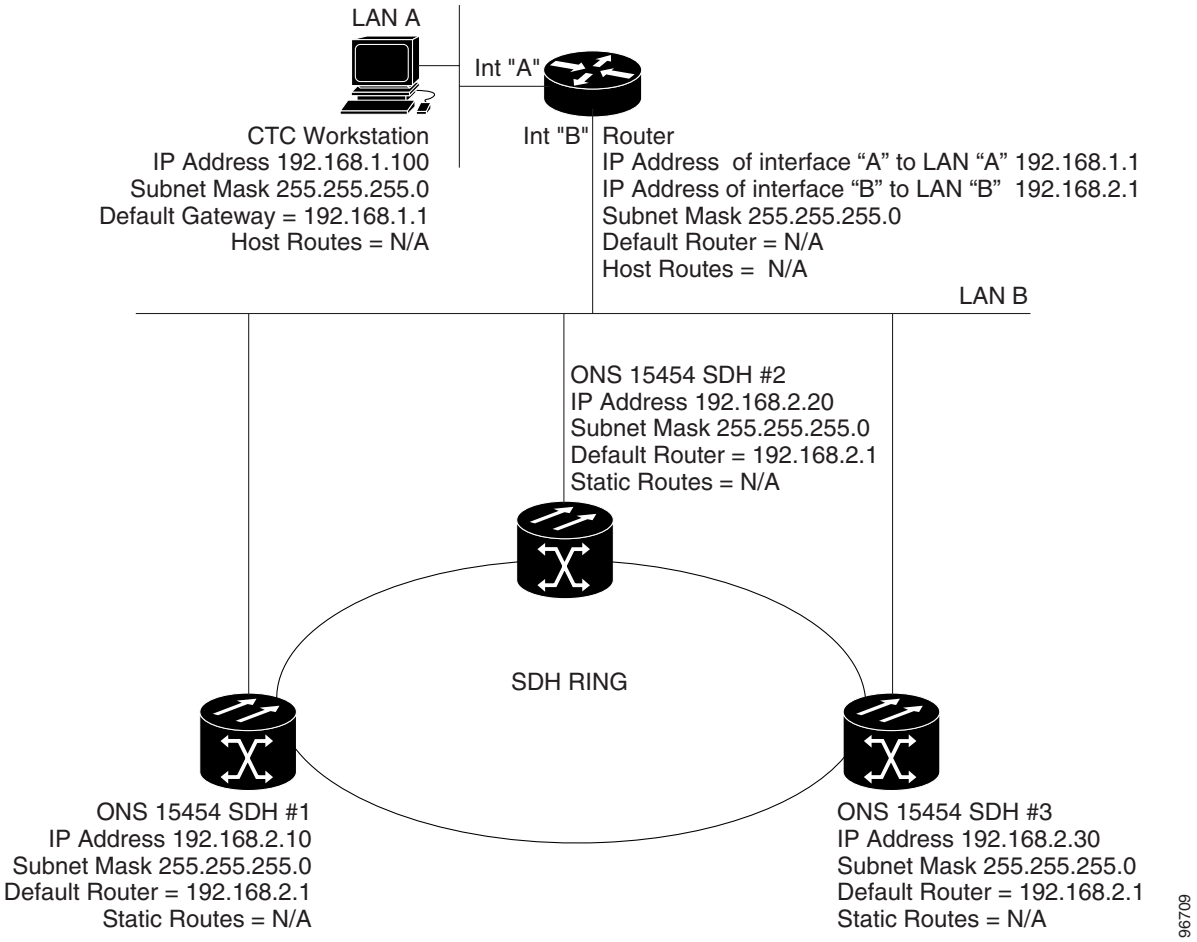


13.2.2 Scenario 2: CTC and ONS 15454 SDH Nodes Connected to a Router

In Scenario 2 the CTC computer resides on a subnet (192.168.1.0) and attaches to LAN A (Figure 13-2). The ONS 15454 SDH nodes reside on a different subnet (192.168.2.0) and attach to LAN B. A router connects LAN A to LAN B. The IP address of router interface A is set to LAN A (192.168.1.1), and the IP address of router interface B is set to LAN B (192.168.2.1).

On the CTC computer, the default gateway is set to router interface A. If the LAN uses Dynamic Host Configuration Protocol (DHCP), the default gateway and IP address are assigned automatically. In the example shown in Figure 13-2, a DHCP server is not available.

Figure 13-2 Scenario 2: CTC and ONS 15454 SDH Nodes Connected to Router



13.2.3 Scenario 3: Using Proxy ARP to Enable an ONS 15454 SDH Gateway

ARP matches higher-level IP addresses to the physical addresses of the destination host. It uses a lookup table (called an ARP cache) to perform the translation. When the address is not found in the ARP cache, a broadcast is sent out on the network with a special format called the ARP request. If one of the machines on the network recognizes its own IP address in the request, it sends an ARP reply back to the requesting host. The reply contains the physical hardware address of the receiving host. The requesting host stores this address in its ARP cache so that all subsequent datagrams (packets) to this destination IP address can be translated to a physical address.

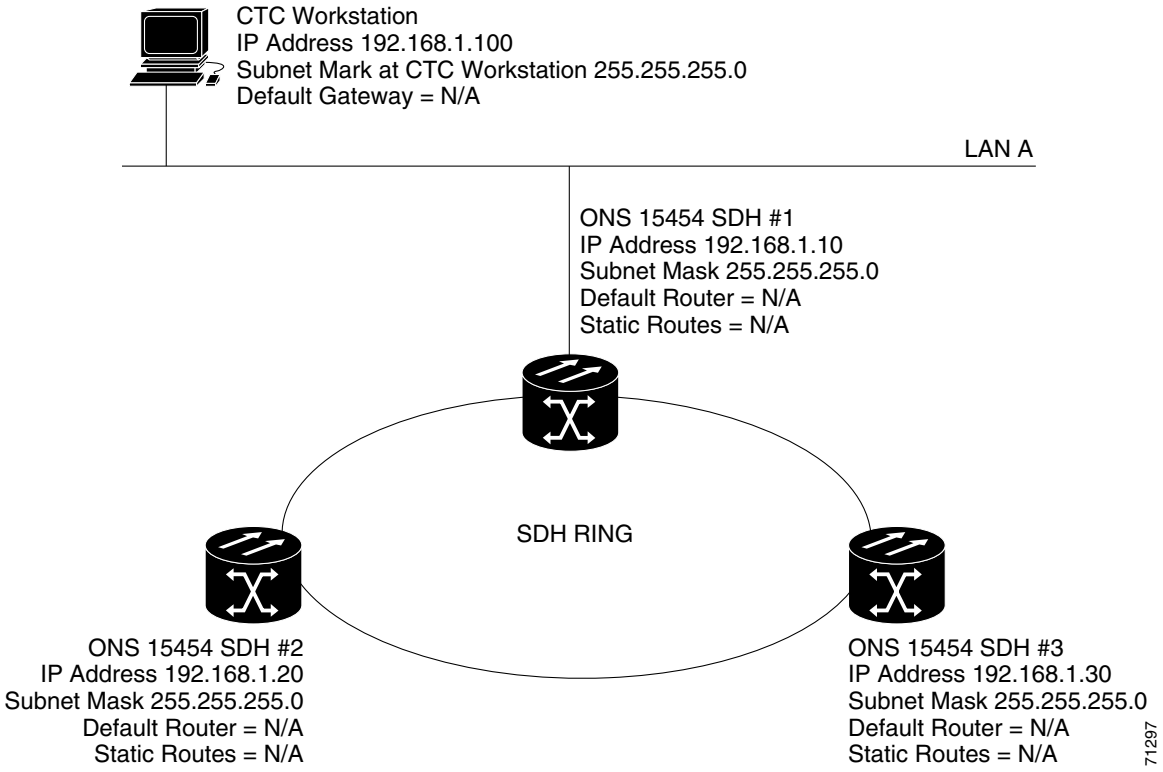
Proxy ARP enables one LAN-connected ONS 15454 SDH to respond to the ARP request for ONS 15454 SDH nodes that are not connected to the LAN. (ONS 15454 SDH proxy ARP requires no user configuration.) The DCC-connected ONS 15454 SDH nodes must reside on the same subnet. When

a LAN device sends an ARP request to an ONS 15454 SDH that is not connected to the LAN, the gateway ONS 15454 SDH returns its MAC address to the LAN device. The LAN device then sends the datagram for the remote ONS 15454 SDH to the MAC address of the proxy ONS 15454 SDH. The proxy ONS 15454 SDH uses its routing table to forward the datagram to the non-LAN ONS 15454 SDH.

Scenario 3 is similar to Scenario 1, but only one ONS 15454 SDH (#1) connects to the LAN (Figure 13-3). Two ONS 15454 SDH nodes (#2 and #3) connect to ONS 15454 SDH #1 through the SDH DCC. Because all three nodes are on the same subnet, proxy ARP enables ONS 15454 SDH #1 to serve as a gateway for ONS 15454 SDH #2 and #3.

Note This scenario assumes all CTC connections are to ONS 15454 SDH #1. If you connect a laptop to ONS 15454 SDH #2 or #3, network partitioning occurs; neither the laptop or the CTC computer can see all nodes. If you want laptops to connect directly to end network elements, you need to create static routes (see Scenario 5) or enable the ONS 15454 SDH proxy server (see Scenario 7).

Figure 13-3 Scenario 3: Using Proxy ARP



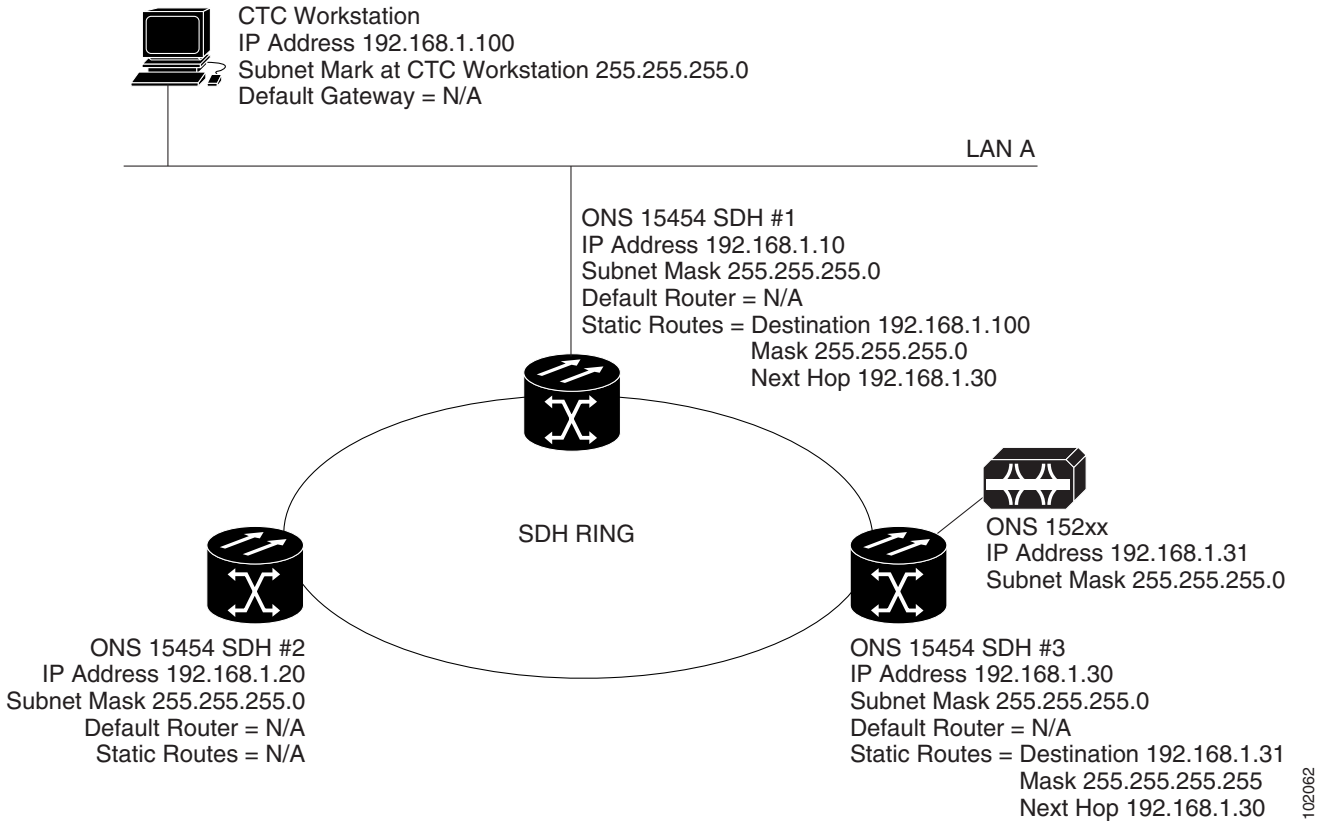
You can also use proxy ARP to communicate with hosts attached to the craft Ethernet ports of DCC-connected nodes (Figure 13-4). The node with an attached host must have a static route to the host. Static routes are propagated to all DCC peers using OSPF. The existing proxy ARP node is the gateway for additional hosts. Each node examines its routing table for routes to hosts that are not connected to the DCC network but are within the subnet. The existing proxy server replies to ARP requests for these additional hosts with the node MAC address. The existence of the host route in the routing table ensures that the IP packets addressed to the additional hosts are routed properly. Other than establishing a static route between a node and an additional host, no provisioning is necessary. The following restrictions apply:

- Only one node acts as the proxy ARP server for any given additional host.

- A node cannot be the proxy ARP server for a host connected to its Ethernet port.

In Figure 13-4, ONS 15454 SDH #1 announces to ONS 15454 SDH #2 and #3 that it can reach the CTC host. Similarly, ONS 15454 SDH #3 announces that it can reach the ONS 152xx. The ONS 152xx is shown as an example; any network element can be set up as an additional host.

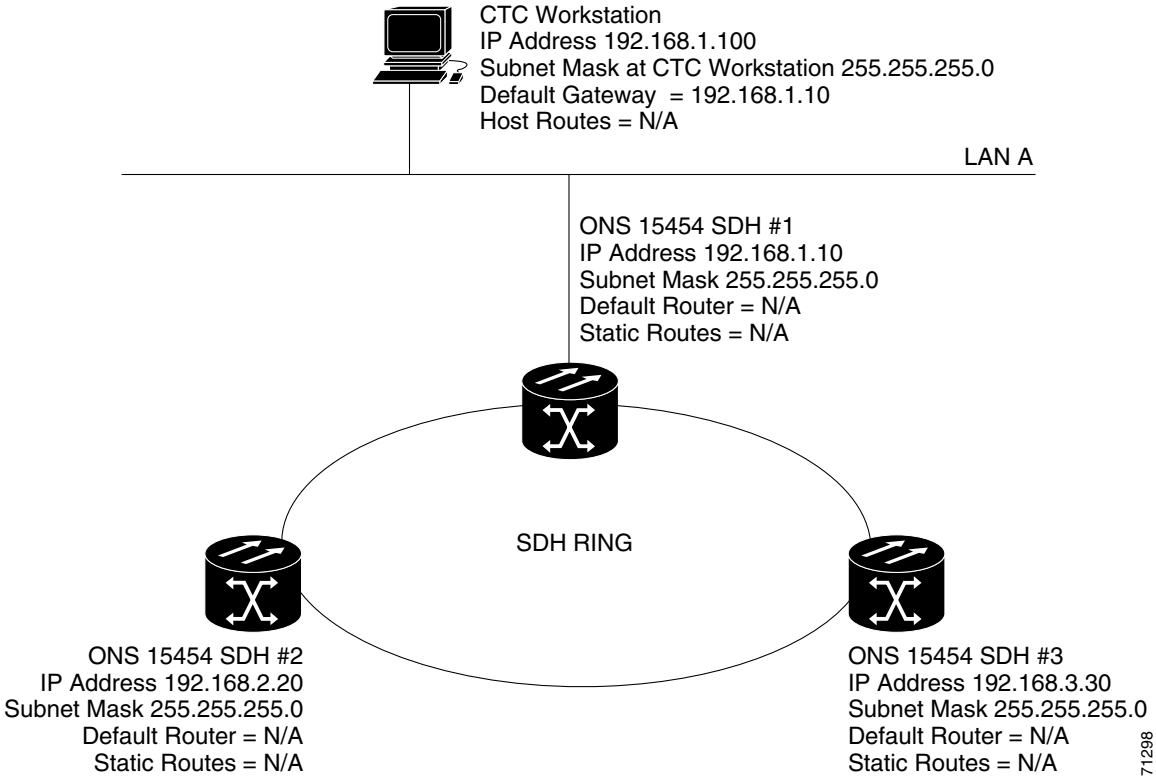
Figure 13-4 Scenario 3: Using Proxy ARP with Static Routing



13.2.4 Scenario 4: Default Gateway on CTC Computer

Scenario 4 is similar to Scenario 3, but Nodes 2 and 3 reside on different subnets, 192.168.2.0 and 192.168.3.0, respectively (Figure 13-5). Node 1 and the CTC computer are on subnet 192.168.1.0. Proxy ARP is not used because the network includes different subnets. In order for the CTC computer to communicate with Nodes 2 and 3, Node 1 is entered as the default gateway on the CTC computer.

Figure 13-5 Scenario 4: Default Gateway on a CTC Computer



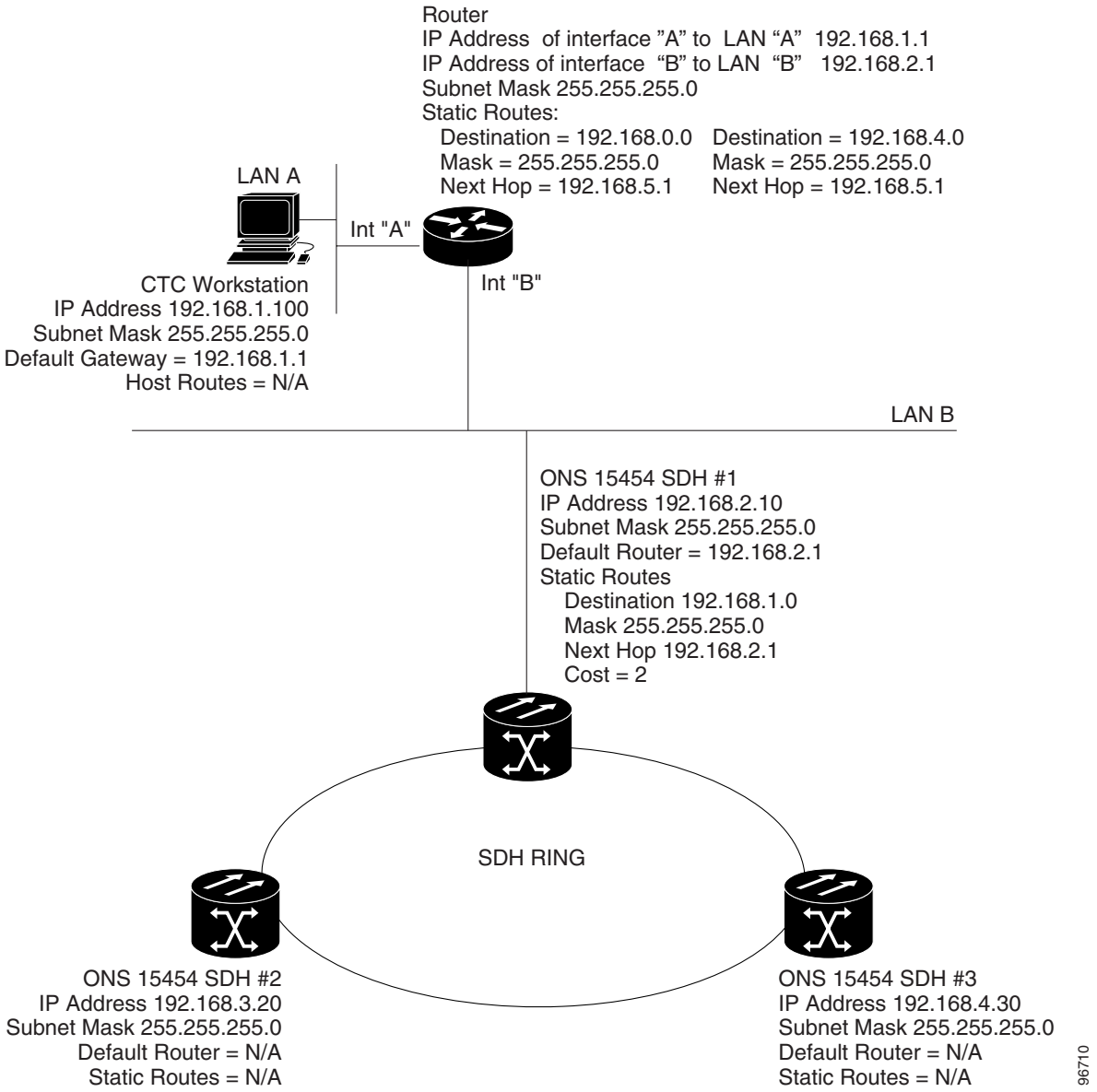
13.2.5 Scenario 5: Using Static Routes to Connect to LANs

Static routes are used for two purposes:

- To connect ONS 15454 SDH nodes to CTC sessions on one subnet that are connected by a router to ONS 15454 SDH nodes residing on another subnet. (These static routes are not needed if OSPF is enabled.) Scenario 6 shows an OSPF example.
- To enable multiple CTC sessions among ONS 15454 SDH nodes residing on the same subnet.

In Figure 13-6, one CTC residing on subnet 192.168.1.0 connects to a router through interface A. (The router is not set up with OSPF.) ONS 15454 SDH nodes residing on different subnets are connected through Node 1 to the router through interface B. Because Nodes 2 and 3 are on different subnets, proxy ARP does not enable Node 1 as a gateway. To connect to CTC computers on LAN A, a static route is created on Node 1.

Figure 13-6 Scenario 5: Static Route With One CTC Computer Used as a Destination

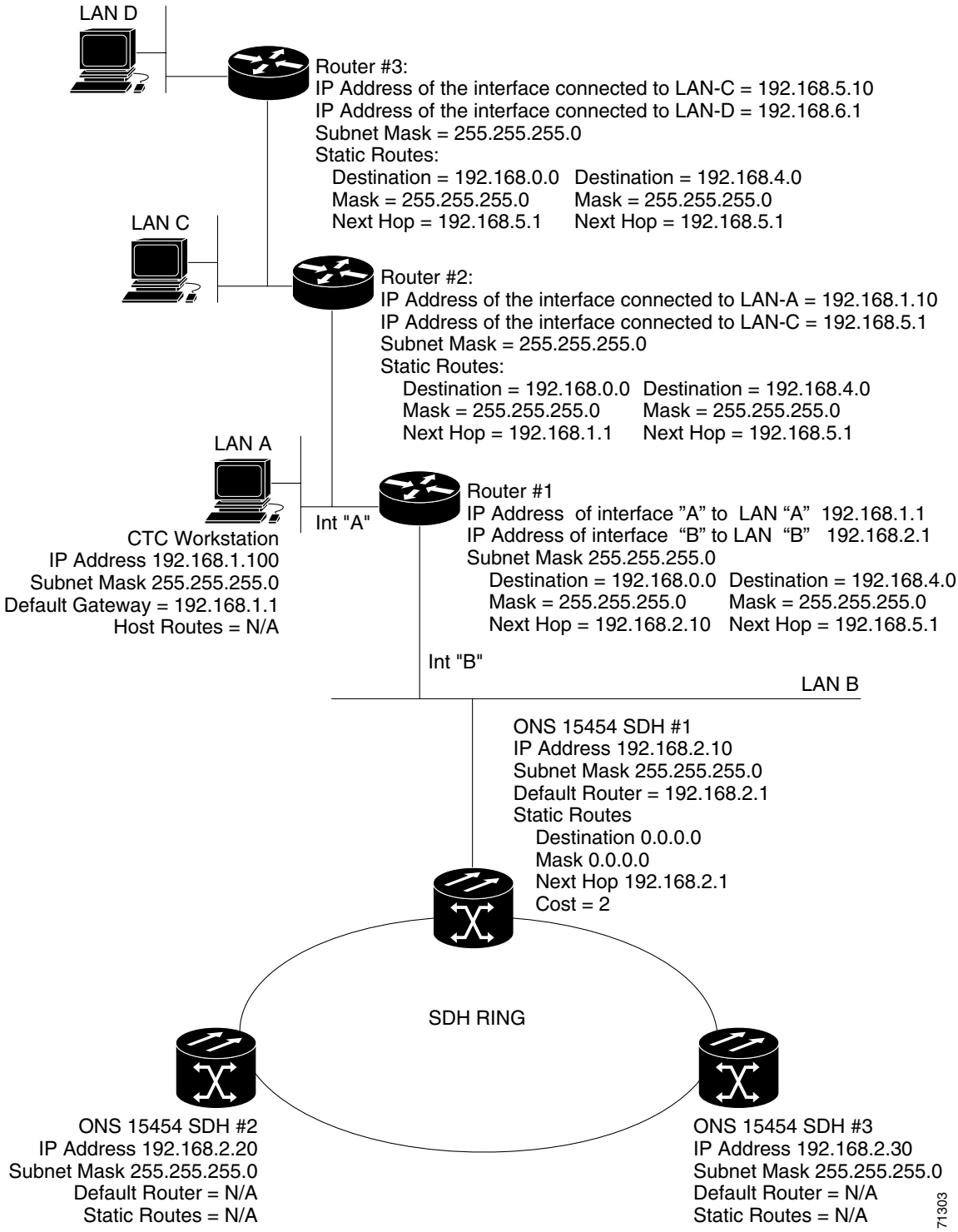


The destination and subnet mask entries control access to the ONS 15454 SDH nodes:

- If a single CTC computer is connected to a router, enter the complete CTC "host route" IP address as the destination with a subnet mask of 255.255.255.255.
- If CTC computers on a subnet are connected to a router, enter the destination subnet (in this example, 192.168.1.0) and a subnet mask of 255.255.255.0.
- If all CTC computers are connected to a router, enter a destination of 0.0.0.0 and a subnet mask of 0.0.0.0. Figure 13-7 shows an example.

The IP address of router interface B is entered as the next hop, and the cost (number of hops from source to destination) is 2.

Figure 13-7 Scenario 5: Static Route With Multiple LAN Destinations



13.2.6 Scenario 6: Using OSPF

Open Shortest Path First (OSPF) is a link state Internet routing protocol. Link state protocols use a "hello protocol" to monitor their links with adjacent routers and to test the status of their links to their neighbors. Link state protocols advertise their directly connected networks and their active links. Each link state router captures the link state "advertisements" and puts them together to create a topology of the entire network or area. From this database, the router calculates a routing table by constructing a shortest path tree. Routes are continuously recalculated to capture ongoing topology changes.

ONS 15454 SDH nodes use the OSPF protocol in internal ONS 15454 SDH networks for node discovery, circuit routing, and node management. You can enable OSPF on the ONS 15454 SDH nodes so that the ONS 15454 SDH topology is sent to OSPF routers on a LAN. Advertising the ONS 15454 SDH network topology to LAN routers eliminates the need to enter static routes for ONS 15454 SDH subnetworks manually.

OSPF divides networks into smaller regions, called areas. An area is a collection of networked end systems, routers, and transmission facilities organized by traffic patterns. Each OSPF area has a unique ID number, known as the area ID. Every OSPF network has one backbone area called "area 0." All other OSPF areas must connect to area 0.

When you enable an ONS 15454 SDH OSPF topology for advertising to an OSPF network, you must assign an OSPF area ID to the ONS 15454 SDH network. Coordinate the area ID number assignment with your LAN administrator. All DCC-connected ONS 15454 SDH nodes should be assigned the same OSPF area ID.

Figure 13-8 shows a network enabled for OSPF.

Figure 13-8 Scenario 6: OSPF Enabled

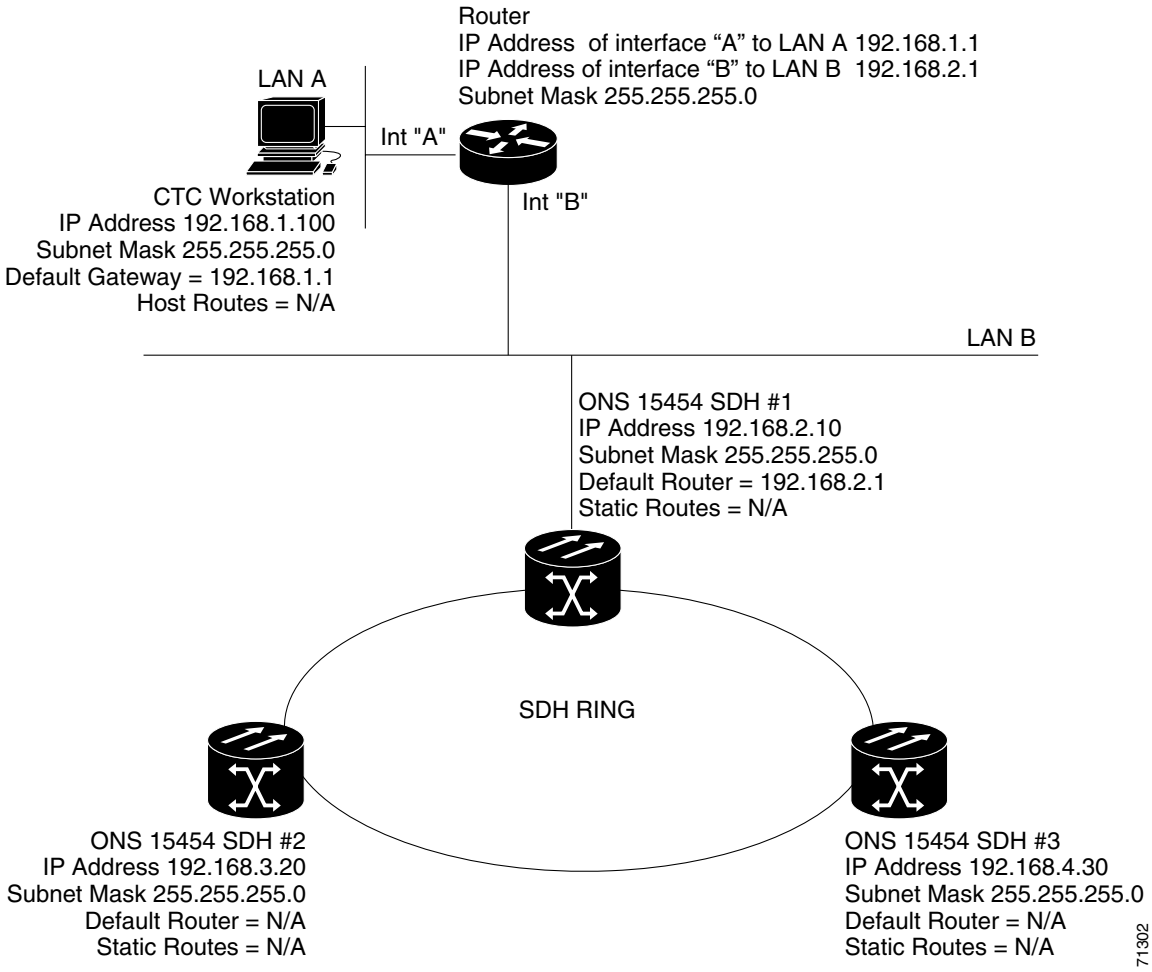
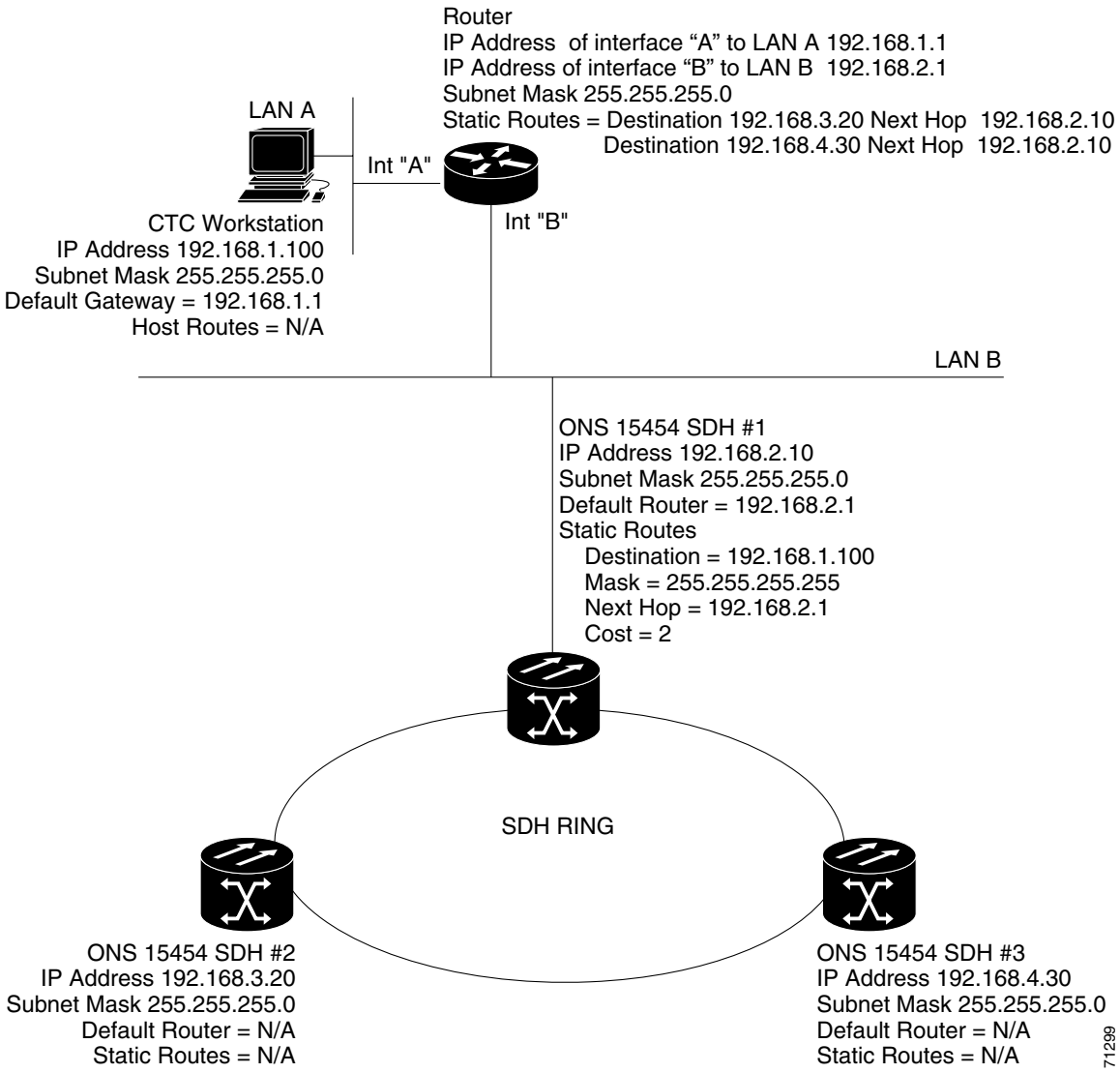


Figure 13-9 shows the same network as Figure 13-8 on page 13-11 without OSPF. Static routes must be manually added to the router for CTC computers on LAN A to communicate with Nodes 2 and 3 because these nodes reside on different subnets.

Figure 13-9 Scenario 6: OSPF Not Enabled



13.2.7 Scenario 7: Provisioning the ONS 15454 SDH Proxy Server

The ONS 15454 SDH proxy server is a set of functions that allows you to network ONS 15454 SDH nodes in environments where visibility and accessibility between ONS 15454 SDH nodes and CTC computers must be restricted. For example, you can set up a network so that field technicians and network operating center (NOC) personnel can access the same ONS 15454 SDH nodes while preventing the field technicians from accessing the NOC LAN. To do this, one ONS 15454 SDH is provisioned as a gateway network element (GNE) and the other ONS 15454 SDH nodes are provisioned as end network elements (ENEs). The GNE tunnels connections between CTC computers and ENE ONS 15454 SDH nodes, providing management capability while preventing access for non-ONS 15454 SDH management purposes.

The ONS 15454 SDH proxy server performs the following tasks:

- Isolates DCC IP traffic from Ethernet (craft port) traffic and accepts packets based on filtering rules. The filtering rules (see Table 13-3 on page 13-17 and Table 13-4 on page 13-18) depend on whether the packet arrives at the ONS 15454 SDH DCC or TCC2/TCC2P Ethernet interface.
- Processes SNTP (Simple Network Time Protocol) and NTP (Network Time Protocol) requests. ENEs can derive time-of-day from an SNTP/NTP LAN server through the GNE ONS 15454 SDH.
- Processes SNMPv1 traps. The GNE ONS 15454 SDH receives SNMPv1 traps from the ENE ONS 15454 SDH nodes and forwards them to all provisioned SNMPv1 trap destinations.

The ONS 15454 SDH proxy server is provisioned using the Enable proxy server on port check box on the Provisioning > Network > General tab (Figure 13-10). If checked, the ONS 15454 SDH serves as a proxy for connections between CTC clients and ONS 15454 SDHs that are DCC-connected to the proxy ONS 15454 SDH. The CTC client establishes connections to DCC-connected nodes through the proxy node. The CTC client can connect to nodes that it cannot directly reach from the host on which it runs. If not selected, the node does not proxy for any CTC clients, although any established proxy connections continue until the CTC client exits. In addition, you can set the proxy server as an ENE or a GNE:

Note If you launch CTC against a node through a NAT (Network Address Translation) or PAT (Port Address Translation) router and that node does not have proxy enabled, your CTC session starts and initially appears to be fine. However CTC never receives alarm updates and disconnects and reconnects every two minutes. If the proxy is accidentally disabled, it is still possible to enable the proxy during a reconnect cycle and recover your ability to manage the node, even through a NAT/PAT firewall.

- External network element (ENE)—If set as an ENE, the ONS 15454 SDH neither installs nor advertises default or static routes. CTC computers can communicate with the ONS 15454 SDH using the TCC2/TCC2P craft port, but they cannot communicate directly with any other DCC-connected ONS 15454 SDH.

  In addition, firewall is enabled, which means that the node prevents IP traffic from being routed between the DCC and the LAN port. The ONS 15454 SDH can communicate with machines connected to the LAN port or connected through the DCC. However, the DCC-connected machines cannot communicate with the LAN-connected machines, and the LAN-connected machines cannot communicate with the DCC-connected machines. A CTC client using the LAN to connect to the firewall-enabled node can use the proxy capability to manage the DCC-connected nodes that would otherwise be unreachable. A CTC client connected to a DCC-connected node can only manage other DCC-connected nodes and the firewall itself.
- Gateway Network Element (GNE)—If set as a GNE, the CTC computer is visible to other DCC-connected nodes and firewall is enabled.
- Proxy-only—If Proxy-only is selected, CTC cannot communicate with any other DCC-connected ONS 15454 SDHs and firewall is not enabled.

Figure 13-10 Proxy Server Gateway Settings

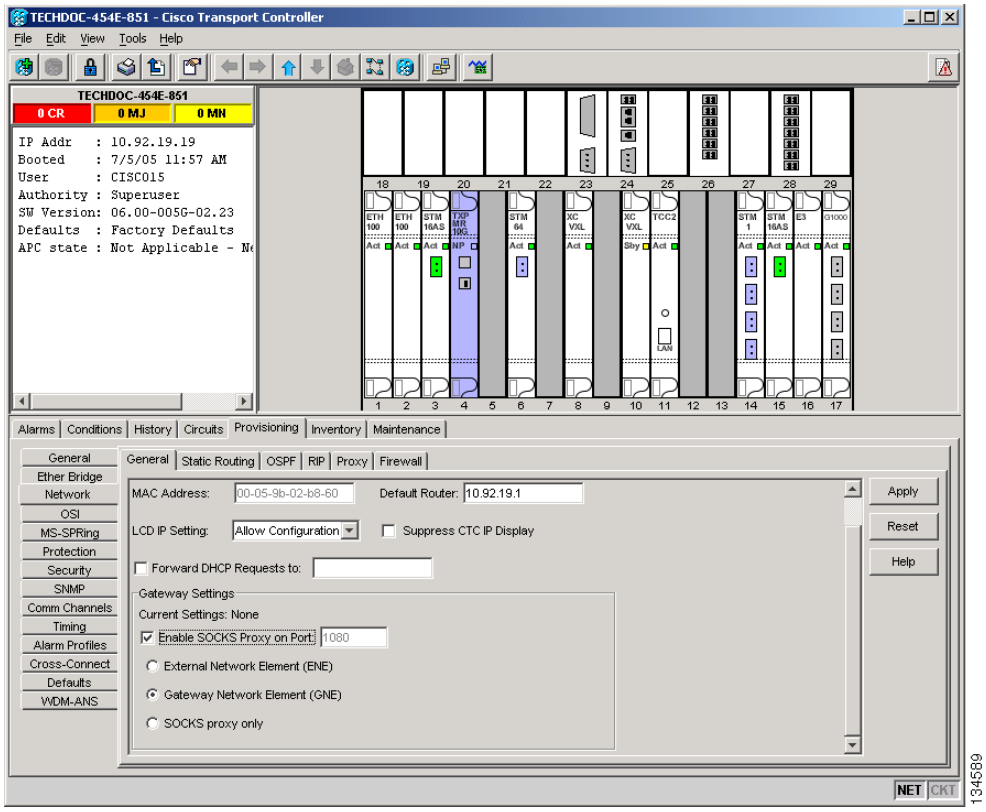


Figure 13-11 shows an ONS 15454 SDH proxy server implementation. A GNE ONS 15454 SDH is connected to a central office LAN and to ENE ONS 15454 SDH nodes. The central office LAN is connected to a NOC LAN, which has CTC computers. The NOC CTC computer and craft technicians must be able to access the ONS 15454 SDH ENEs. However, the craft technicians must be prevented from accessing or seeing the NOC or central office LANs.

In the example, the ONS 15454 SDH GNE is assigned an IP address within the central office LAN and is physically connected to the LAN through its LAN port. ONS 15454 SDH ENEs are assigned IP addresses that are outside the central office LAN and given private network IP addresses. If the ONS 15454 SDH ENEs are collocated, the craft LAN ports could be connected to a hub. However, the hub should have no other network connections.

Figure 13-11 Scenario 7: SDH Proxy Server with GNE and ENEs on the Same Subnet

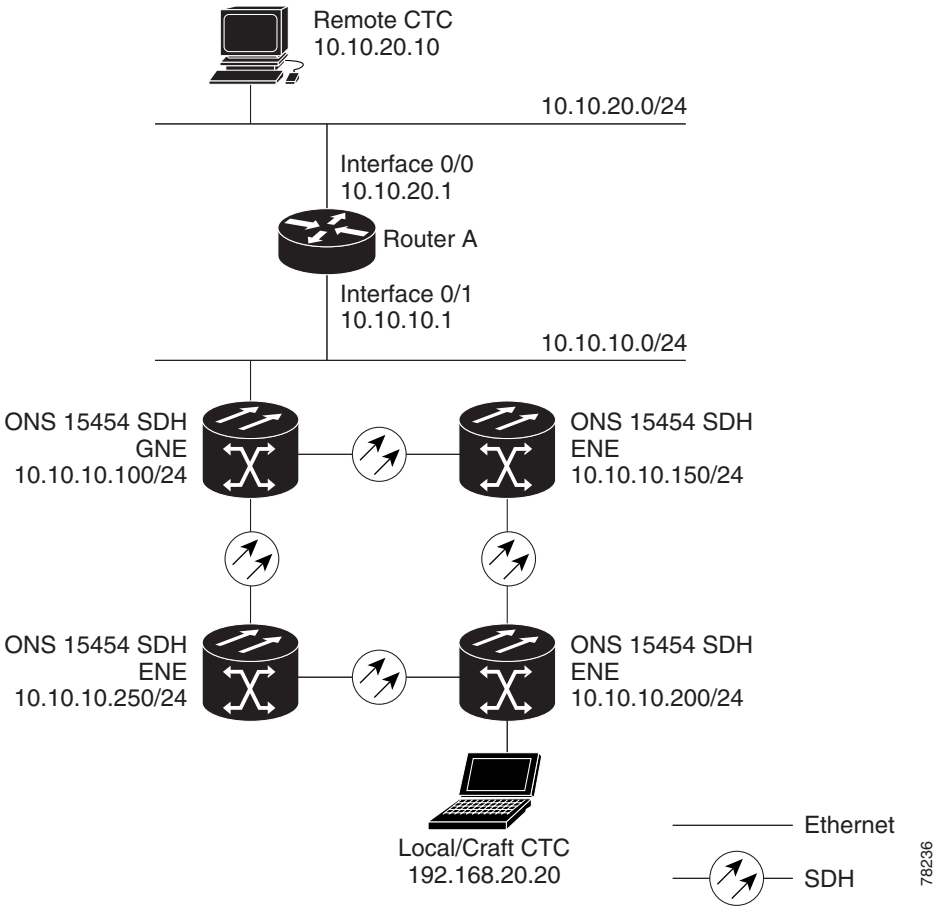


Table 13-2 shows recommended settings for ONS 15454 SDH GNEs and ENEs in the configuration shown in Figure 13-11.

Table 13-2 ONS 15454 SDH GNE and ENE Settings

Setting	ONS 15454 SDH GNE	ONS 15454 SDH ENE
Craft Access Only	Off	On
Enable Proxy	On	On
Enable Firewall	On	On
OSPF	Off	Off
SNTP Server (if used)	SNTP server IP address	Set to ONS 15454 SDH GNE IP address
SNMP (if used)	SNMPv1 trap destinations	Set SNMPv1 trap destinations to ONS 15454 SDH GNE, port 391

Figure 13-12 shows the same proxy server implementation with ONS 15454 SDH ENEs on different subnets. In the example, ONS 15454 SDH GNEs and ENEs are provisioned with the settings shown in Table 13-2.

Figure 13-12 Scenario 7: ONS 15454 SDH Proxy Server with GNE and ENEs on Different Subnets

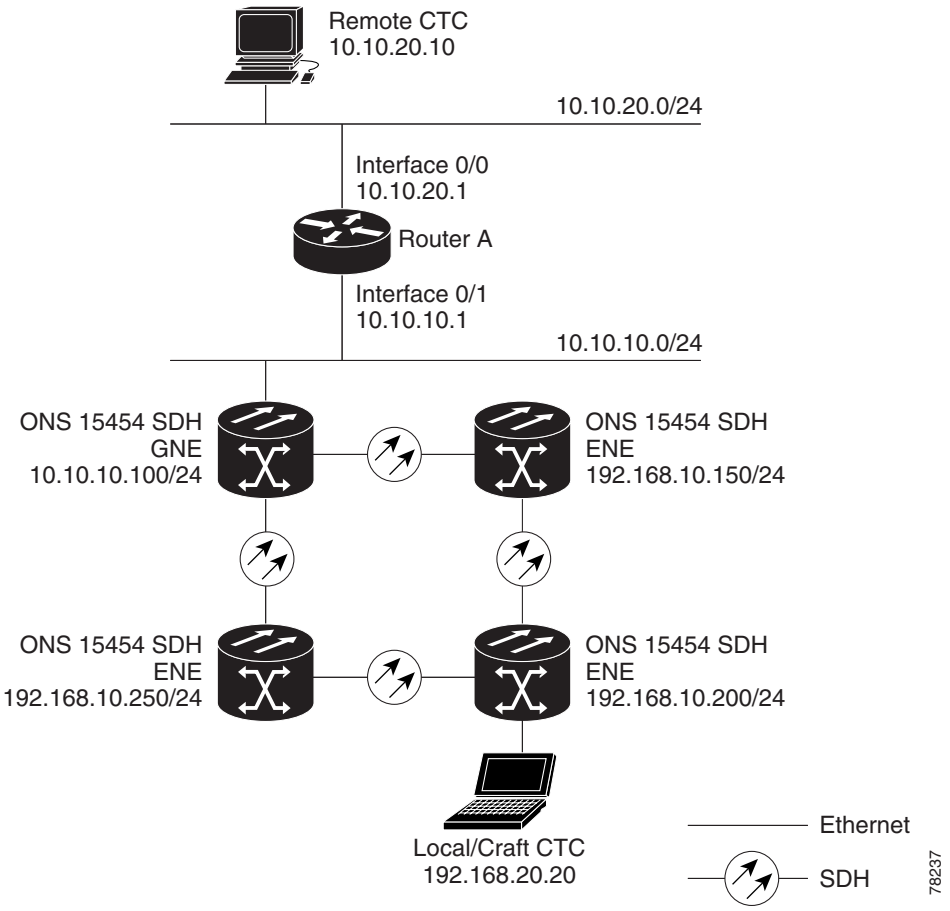


Figure 13-13 shows the implementation with ONS 15454 SDH ENEs in multiple rings. In the example, ONS 15454 SDH GNEs and ENEs are provisioned with the settings shown in Table 13-2 on page 13-15.

Figure 13-13 Scenario 7: ONS 15454 SDH Proxy Server With ENEs on Multiple Rings

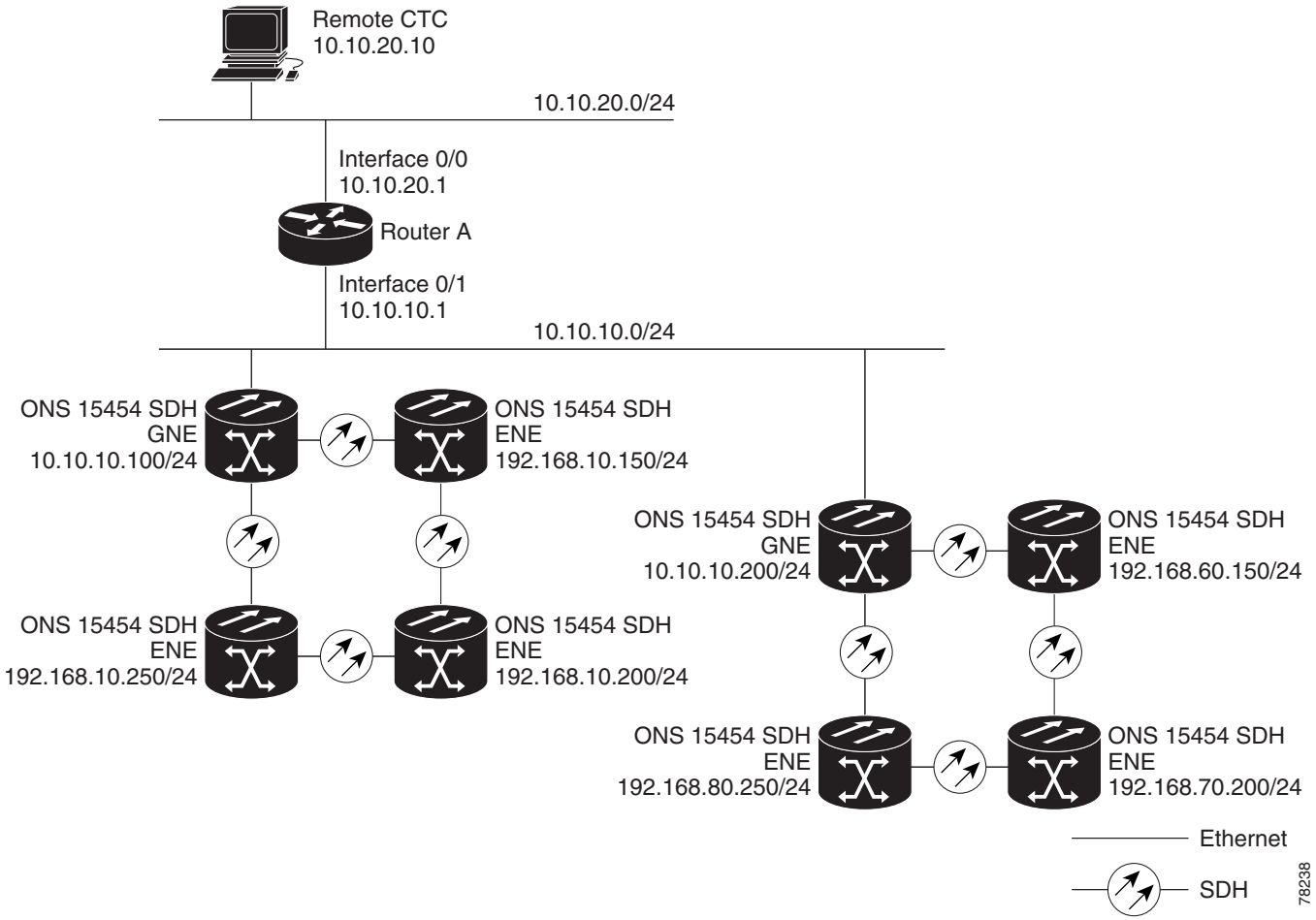


Table 13-3 shows the rules the ONS 15454 SDH follows to filter packets when Enable Firewall is enabled.

Table 13-3 Proxy Server Firewall Filtering Rules

Packets Arriving At:	Are Accepted if the IP Destination Address is:
TCC2/TCC2P Ethernet interface	• The ONS 15454 SDH itself • The ONS 15454 SDH node's subnet broadcast address • Within the 224.0.0.0/8 network (reserved network used for standard multicast messages) • Subnet mask = 255.255.255.255
DCC interface	• The ONS 15454 SDH itself • Any destination connected through another DCC interface • Within the 224.0.0.0/8 network

If the packet is addressed to the ONS 15454 SDH, additional rules apply (Table 13-4). Rejected packets are silently discarded.

Table 13-4 Proxy Server Firewall Filtering Rules When Packet Addressed to ONS 15454 SDH

Packets Arriving At	Accepts	Rejects
TCC2/TCC2P Ethernet interface	• All UDP packets except those in the Rejected column	• UDP packets addressed to the SNMP trap relay port (391)
DCC interface	• All UDP packets • All TCP packets except packets addressed to the Telnet and SOCKS proxy server ports • OSPF packets • ICMP packets	• TCP packets addressed to the Telnet port • TCP packets addressed to the proxy server port • All packets other than UDP, TCP, OSPF, and ICMP.

If you implement the proxy server, keep the following rules in mind:

- All DCC-connected ONS 15454 SDH nodes on the same Ethernet segment must have the same Craft Access Only setting. Mixed values produce unpredictable results, and might leave some nodes unreachable through the shared Ethernet segment.
- All DCC-connected ONS 15454 SDH nodes on the same Ethernet segment must have the same Enable Firewall setting. Mixed values produce unpredictable results. Some nodes might become unreachable.
- If you check Enable Firewall, always check Enable Proxy. If Enable Proxy is not checked, CTC cannot see nodes on the DCC side of the ONS 15454 SDH.
- If Craft Access Only is checked, check Enable Proxy. If Enable Proxy is not checked, CTC cannot see nodes on the DCC side of the ONS 15454 SDH.

If nodes become unreachable in cases 1, 2, and 3, you can correct the setting with one of the following actions:

- Disconnect the craft computer from the unreachable ONS 15454 SDH. Connect to the ONS 15454 SDH through another ONS 15454 SDH in the network that has a DCC connection to the unreachable ONS 15454 SDH.
- Disconnect the Ethernet cable from the unreachable ONS 15454 SDH. Connect a CTC computer directly to the ONS 15454 SDH.

13.2.8 Scenario 8: Dual GNEs on a Subnet

The ONS 15454 SDH provides GNE load balancing, which allows CTC to reach ENEs over multiple GNEs without the ENEs being advertised over OSPF. This feature allows a network to quickly recover from the loss of GNE, even if the GNE is on a different subnet. If a GNE fails, all connections through that GNE fail. CTC disconnects from the failed GNE and from all ENEs for which the GNE was a proxy, and then reconnects through the remaining GNEs. GNE load balancing reduces the dependency on the launch GNE and DCC bandwidth, both of which enhance CTC performance. Figure 13-14 shows a network with dual GNEs on the same subnet.

Figure 13-14 Scenario 8: Dual GNEs on the Same Subnet

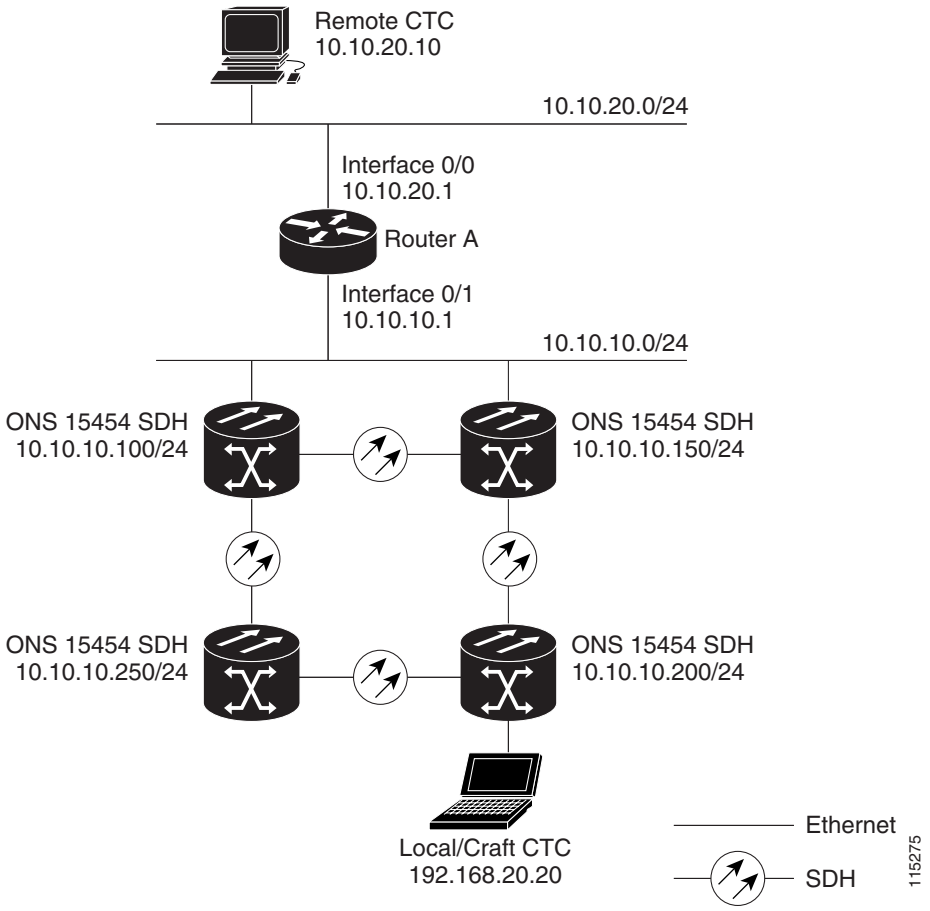
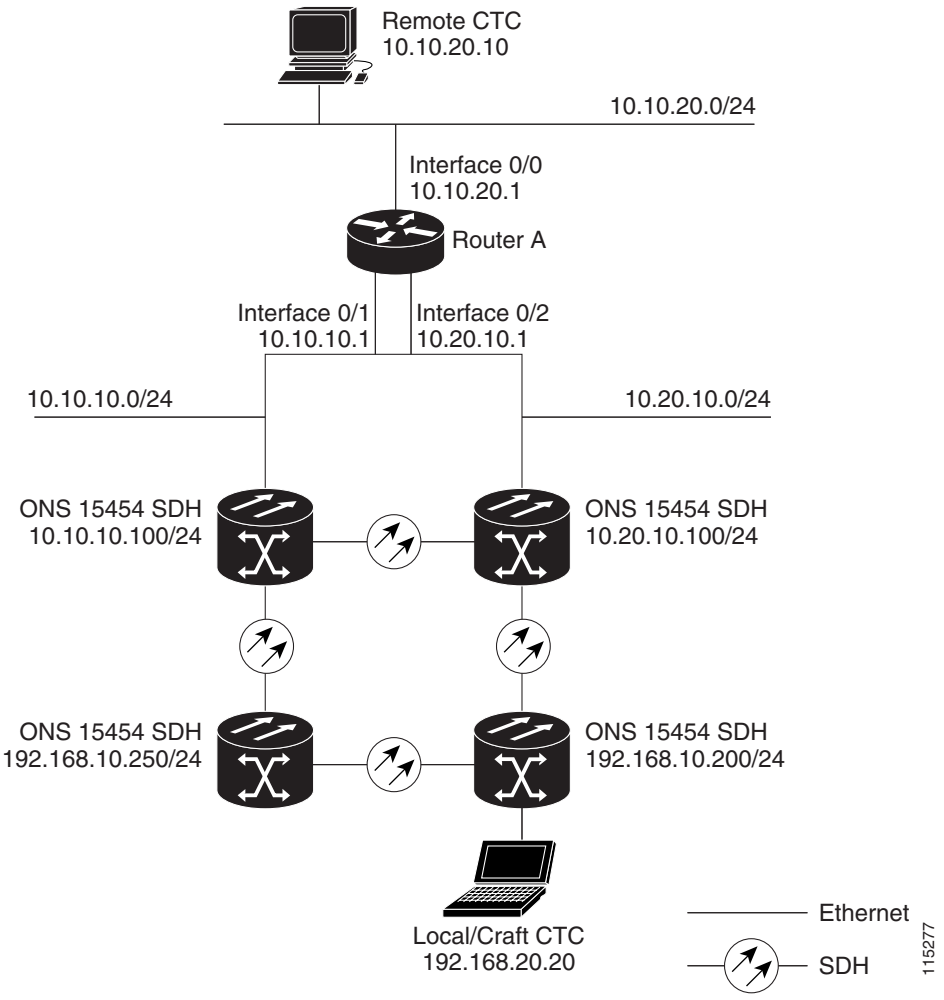


Figure 13-15 shows a network with dual GNEs on different subnets.

Figure 13-15 Scenario 8: Dual GNEs on Different Subnets



13.2.9 Scenario 9: IP Addressing with Secure Mode Enabled

TCC2P cards provide a secure mode option allowing you to provision two IP addresses for the ONS 15454 SDH. One IP address is provisioned for the ONS 15454 SDH MIC-C/T/P LAN port. The other IP address is provisioned for the TCC2P TCP/IP craft port. The two IP addresses provide an additional layer of separation between the craft access port and the ONS 15454 SDH LAN. If secure mode is enabled, the IP addresses provisioned for the TCC2P TCP/IP ports must follow general IP addressing guidelines. In addition, TCC2P TCP/IP craft port addresses must reside on a different subnet from the ONS 15454 SDH MIC-C/T/P port and ONS 15454 SDH default router IP addresses.

The IP address assigned to the MIC-C/T/P LAN port becomes a private address, which is used to connect the ONS 15454 SDH GNE to an OSS (Operations Support System) through a central office LAN or private enterprise network. In secure mode, the MIC-C/T/P LAN IP address is not displayed on the CTC node view or to a technician directly connected to the node by default. This default can be changed to allow the MIC-C/T/P IP address to be displayed on CTC only by a Superuser.

Figure 13-16 shows an example of ONS 15454 SDH nodes on the same subnet with secure mode enabled.In the example, TCC2P port addresses are on a different subnet from the node MIC-C/T/P IP addresses.

Note Secure mode is not available if TCC2 cards are installed. If one TCC2 and one TCC2P card are installed, secure mode will appear in CTC but cannot be modified.

Figure 13-16 Scenario 9: ONS 15454 SDH GNE and ENEs on the Same Subnet with Secure Mode Enabled

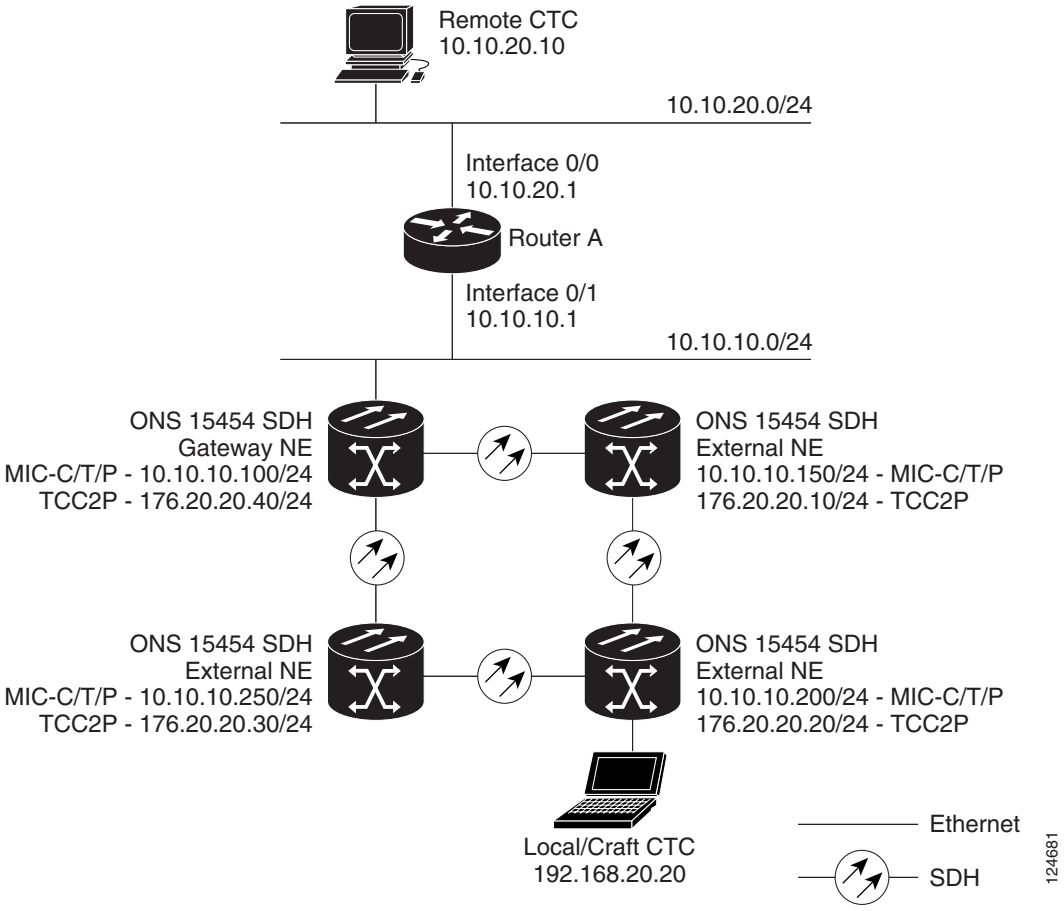
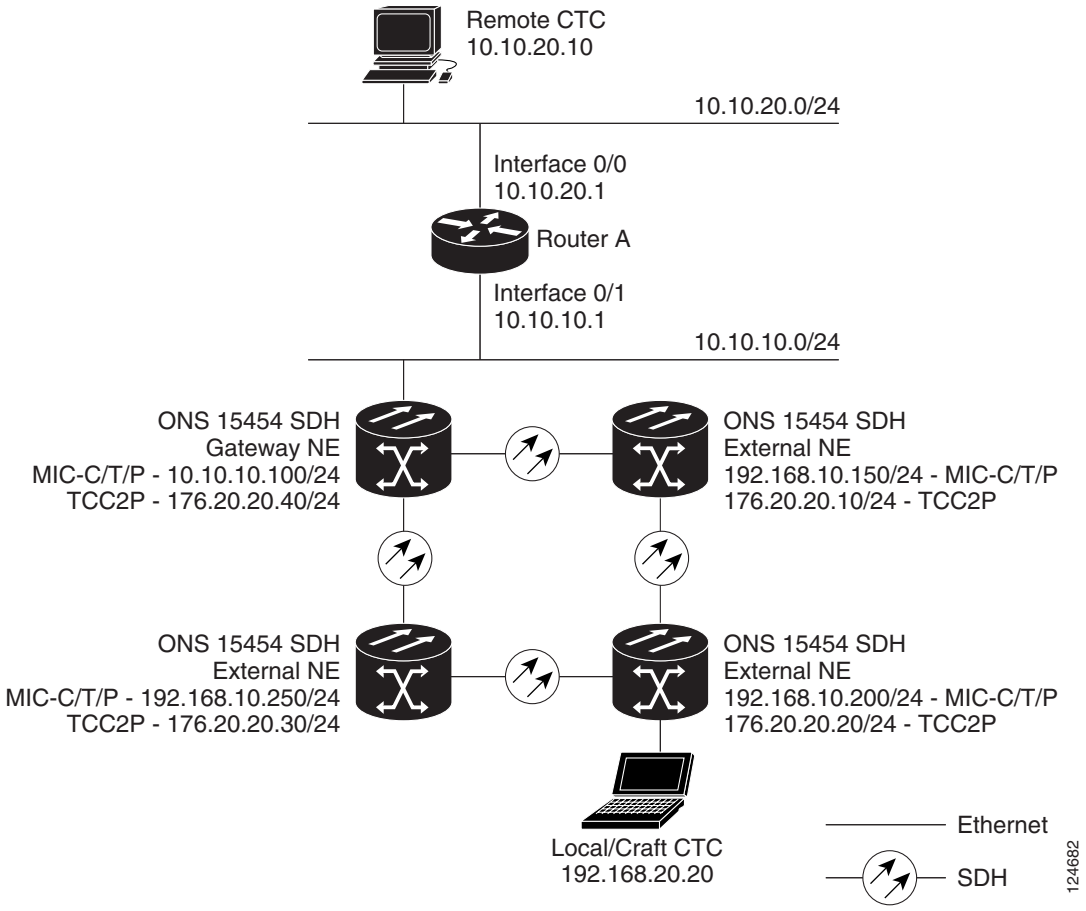


Figure 13-17 shows an example of ONS 15454 SDH nodes connected to a router with secure mode enabled. In the example, TCC2P port addresses are on a different subnet from the node MIC-C/T/P IP addresses.

Figure 13-17 Scenario 9: ONS 15454 SDH GNE and ENEs on Different Subnets with Secure Mode Enabled



13.3 Provisionable Patchcords

A provisionable patchcord is a user-provisioned link that is advertised by OSPF throughout the network. Provisionable patchcords, also called virtual links, are needed in the following situations:

- An optical port is connected to a transponder or muxponder client port provisioned in transparent mode.
- An optical ITU port is connected to a DWDM optical channel card.
- Two transponder or muxponder trunk ports are connected to a DWDM optical channel card and the generic control channel (GCC) is carried transparently through the ring.
- Transponder or muxponder client and trunk ports are in a regenerator group, the cards are in transparent mode, and DCC/GCC termination is not available.

Provisionable patchcords are required on both ends of a physical link. The provisioning at each end includes a local patchcord ID, slot/port information, remote IP address, and remote patchcord ID. Patchcords appear as dashed lines in CTC network view.

Table 13-5 lists the supported card combinations for client and trunk ports in a provisionable patchcord.

Table 13-5 Client-to-Trunk Card Combinations for Provisionable Patchcords

	Client Cards						
Trunk Cards	**MXP_2.5G_10G/ TXP_MR_10G**	**TXP(P)_MR_ 2.5G**	**MXP_2.5G_10E/ TXP_MR_10E**	**32MUX-O 32DMX-O**	**32-WSS/ 32-DMX**	**ADxC**	**4MD**
MXP_2.5G_10G/ TXP_MR_10G	—	—	—	Yes	Yes	Yes	Yes
TXPP_MR_2.5G	—	—	—	Yes	Yes	Yes	Yes
MXP_2.5G_10E/ TXP_MR_10E	—	—	—	Yes	Yes	Yes	Yes
MXPP_MR_2.5G	—	—	—	Yes	Yes	Yes	Yes
OC-192	Yes	—	Yes	—	—	—	—
OC-48	Yes	Yes	Yes	—	—	—	—
OC-192 ITU	—	—	—	Yes	Yes	Yes	Yes
OC-48 ITU	—	—	—	Yes	Yes	Yes	Yes

Note If the OCSM card is installed in Slot 8, provisionable patchcords from OC-N ports to the following cards are not supported on the same node: MXP_2.5G_10G, TXP_MR_10G, TXP(P)_MR_2.5G, MXP_2.5G_10E, TXP_MR_10E, 32MUX-O, 32DMX-O, 32-WSS, or 32-DMX.

Table 13-6 lists the supported card combinations for client-to-client ports in a patchcord.

Table 13-6 Client-to-Client Card Combinations for Provisionable Patchcords

Client Cards	**MXP_2.5G_10G/ TXP_MR_10G**	**TXP(P)_MR_2.5G**	**MXP_2.5G_10E/ TXP_MR_10E**
MXP_2.5G_10G/ TXP_MR_10G	Yes	—	Yes
TXP(P)_MR_2.5G	—	Yes	—
MXP_2.5G_10E/ TXP_MR_10E	Yes	—	Yes

Table 13-7 lists the supported card combinations for trunk-to-trunk ports in a patchcord.

Table 13-7 Trunk-to-Trunk Card Combinations for Provisionable Patchcords

Trunk Cards	**MXP_2.5G_10G/ TXP_MR_10G**	**TXP(P)_MR_2.5G**	**MXP_2.5G_10E/ TXP_MR_10E**
MXP_2.5G_10G/ TXP_MR_10G	Yes	—	Yes
TXP(P)_MR_2.5G	—	Yes	—
MXP_2.5G_10E/ TXP_MR_10E	Yes	—	Yes

Optical ports have the following requirements when used in a provisionable patchcord:

- An optical port connected to transponder/muxponder port or add/drop multiplexer or multiplexer/demultiplexer port requires an RS-DCC/MS-DCC termination.
- If the optical port is the protection port in a 1+1 group, the working port must have an RS-DCC/MS-DCC termination provisioned.
- If the remote end of a patchcord is Y-cable protected or is an add/drop multiplexer or multiplexer/demultiplexer port, an optical port requires two patchcords.

Transponder and muxponder ports have the following requirements when used in a provisionable patchcord:

- Two patchcords are required when a transponder/muxponder port is connected to an add/drop multiplexer or multiplexer/demultiplexer port. CTC automatically prompts the user to set up the second patchcord.
- If a patchcord is on a client port in a regenerator group, the other end of the patchcord must be on the same node and on a port within the same regenerator group.
- A patchcord is allowed on a client port only if the card is in transparent mode.

DWDM cards support provisionable patchcords only on optical channel ports. Each DWDM optical channel port can have only one provisionable patchcord.

Note For TXP, MXP, and DWDM card information, refer to the *Cisco ONS 15454 DWDM Installation and Operations Guide*.

13.4 Routing Table

ONS 15454 SDH routing information appears on the Maintenance > Routing Table tabs. The routing table provides the following information:

- Destination—Displays the IP address of the destination network or host.
- Mask—Displays the subnet mask used to reach the destination host or network.
- Gateway—Displays the IP address of the gateway used to reach the destination network or host.
- Usage—Shows the number of times the listed route has been used.
- Interface—Shows the ONS 15454 SDH interface used to access the destination. Values are:
  - motfcc0—The ONS 15454 SDH Ethernet interface, that is, the RJ-45 jack on the TCC2/TCC2P card and the LAN connection on the MIC-C/T/P FMEC
  - pdcc0—A DCC/OSC/GCC interface.
  - lo0—A loopback interface

Table 13-8 shows sample routing entries for an ONS 15454 SDH.

Table 13-8 Sample Routing Table Entries

Entry	Destination	Mask	Gateway	Interface
1	0.0.0.0	0.0.0.0	172.20.214.1	motfcc0
2	172.20.214.0	255.255.255.0	172.20.214.92	motfcc0
3	172.20.214.92	255.255.255.255	127.0.0.1	lo0

Table 13-8 Sample Routing Table Entries (continued)

Entry	Destination	Mask	Gateway	Interface
4	172.20.214.93	255.255.255.255	0.0.0.0	pdcc0
5	172.20.214.94	255.255.255.255	172.20.214.93	pdcc0

Entry 1 shows the following:

- Destination (0.0.0.0) is the default route entry. All undefined destination network or host entries on this routing table are mapped to the default route entry.
- Mask (0.0.0.0) is always 0 for the default route.
- Gateway (172.20.214.1) is the default gateway address. All outbound traffic that cannot be found in this routing table or is not on the node's local subnet are sent to this gateway.
- Interface (motfcc0) indicates that the ONS 15454 SDH Ethernet interface is used to reach the gateway.

Entry 2 shows the following:

- Destination (172.20.214.0) is the destination network IP address.
- Mask (255.255.255.0) is a 24-bit mask, meaning all addresses within the 172.20.214.0 subnet can be a destination.
- Gateway (172.20.214.92) is the gateway address. All outbound traffic belonging to this network is sent to this gateway.
- Interface (motfcc0) indicates that the ONS 15454 SDH Ethernet interface is used to reach the gateway.

Entry 3 shows the following:

- Destination (172.20.214.92) is the destination host IP address.
- Mask (255.255.255.255) is a 32 bit mask, meaning only the 172.20.214.92 address is a destination.
- Gateway (127.0.0.1) is a loopback address. The host directs network traffic to itself using this address.
- Interface (lo0) indicates that the local loopback interface is used to reach the gateway.

Entry 4 shows the following:

- Destination (172.20.214.93) is the destination host IP address.
- Mask (255.255.255.255) is a 32 bit mask, meaning only the 172.20.214.93 address is a destination.
- Gateway (0.0.0.0) means the destination host is directly attached to the node.
- Interface (pdcc0) indicates that an SDH RS-DCC interface is used to reach the destination host.

Entry 5 shows a DCC-connected node that is accessible through a node that is not directly connected:

- Destination (172.20.214.94) is the destination host IP address.
- Mask (255.255.255.255) is a 32-bit mask, meaning only the 172.20.214.94 address is a destination.
- Gateway (172.20.214.93) indicates that the destination host is accessed through a node with IP address 172.20.214.93.
- Interface (pdcc0) indicates that a SDH RS-DCC interface is used to reach the gateway.

13.5 External Firewalls

This section provides sample access control lists for external firewalls. Table 13-9 lists the ports that are used by the TCC2/TCC2P card.

Table 13-9 Ports Used by the TCC2/TCC2P

Port	Function	Action[1]
0	Never used	D
20	FTP	D
21	FTP control	D
22	SSH (Secure Shell)	D
23	Telnet	D
80	HTTP	D
111	SUNRPC (Sun Remote Procedure Call)	NA
161	SNMP traps destinations	D
162	SNMP traps destinations	D
513	rlogin	D
683	CORBA IIOP	OK
1080	Proxy server (socks)	D
2001-2017	I/O card Telnet	D
2018	DCC processor on active TCC2/TCC2P	D
2361	TL1	D
3082	Raw TL1	D
3083	TL1	D
5001	BLSR server port	D
5002	BLSR client port	D
7200	SNMP alarm input port	D
9100	EQM port	D
9401	TCC boot port	D
9999	Flash manager	D
10240-12287	Proxy client	D
57790	Default TCC listener port	OK

1. D = deny, NA = not applicable, OK = do not deny

The following access control list (ACL) example shows a firewall configuration when the proxy server gateway setting is not enabled. In the example, the CTC workstation's address is 192.168.10.10. and the ONS 15454 SDH address is 10.10.10.100 The firewall is attached to the GNE CTC, so inbound is CTC to the GNE and outbound is from the GNE to CTC. The CTC Common Object Request Broker Architecture (CORBA) Standard constant is 683 and the TCC CORBA Default TCC Fixed (57790).

```
access-list 100 remark *** Inbound ACL, CTC -> NE ***
access-list 100 remark
```

```
access-list 100 permit tcp host 192.168.10.10 any host 10.10.10.100 eq www
access-list 100 remark *** allows initial contact with ONS 15454 SDH using http (port 80)
access-list 100 remark
access-list 100 permit tcp host 192.168.10.10 683 host 10.10.10.100 eq 57790
access-list 100 remark *** allows CTC communication with ONS 15454 SDH GNE (port 57790)
***
access-list 101 remark *** Outbound ACL, NE -> CTC ***
access-list 101 remark
access-list 101 permit tcp host 10.10.10.100 any host 192.168.10.10 eq 683
access-list 101 remark *** allows alarms etc., from ONS 15454 SDH (random port) to the CTC
workstation (port 683) ***
access-list 100 remark
access-list 101 permit tcp host 10.10.10.100 host 192.168.10.10 established
access-list 101 remark *** allows ACKs from ONS 15454 SDH GNE to CTC ***
```

The following ACL example shows a firewall configuration when the proxy server gateway setting is enabled. As with the first example, the CTC workstation address is 192.168.10.10 and the ONS 15454 SDH address is 10.10.10.100. The firewall is attached to the GNE CTC, so inbound is CTC to the GNE and outbound is from the GNE to CTC. CTC CORBA Standard constant (683) and TCC CORBA Default TCC Fixed (57790).

```
access-list 100 remark *** Inbound ACL, CTC -> NE ***
access-list 100 remark
access-list 100 permit tcp host 192.168.10.10 any host 10.10.10.100 eq www
access-list 100 remark *** allows initial contact with the 15454 SDH using http (port 80)
***
access-list 100 remark
access-list 100 permit tcp host 192.168.10.10 683 host 10.10.10.100 eq 57790
access-list 100 remark *** allows CTC communication with the 15454 SDH GNE (port 57790)
***
access-list 100 remark
access-list 100 permit tcp host 192.168.10.10 683 host 10.10.10.100 eq 1080
access-list 100 remark *** allows CTC communication with the 15454 SDH GNE proxy server
(port 1080) ***
access-list 100 remark
access-list 100 permit tcp host 192.168.10.10 683 host 10.10.10.100 range 10240 10495
access-list 100 remark *** allows CTC communication with the 15454 SDH ENEs (ports 10240 -
10495) via the GNE proxy server
***
access-list 100 remark
access-list 100 permit tcp host 192.168.10.10 host 10.10.10.100 established
access-list 100 remark *** allows ACKs from CTC to the 15454 SDH GNE ***

access-list 101 remark *** Outbound ACL, NE -> CTC ***
access-list 101 remark
access-list 101 permit tcp host 10.10.10.100 any host 192.168.10.10 eq 683
access-list 101 remark *** allows alarms and other communications from the 15454 SDH
(random port) to the CTC workstation
(port 683) ***
access-list 100 remark
access-list 101 permit tcp host 10.10.10.100 host 192.168.10.10 established
access-list 101 remark *** allows ACKs from the 15454 SDH GNE to CTC ***
```

13.6 Open GNE

The ONS 15454 SDH can communicate with non-ONS nodes that do not support point-to-point protocol (PPP) vendor extensions or OSPF type 10 opaque link-state advertisements (LSA), both of which are necessary for automatic node and link discovery. An open GNE configuration allows the DCC-based network to function as an IP network for non-ONS nodes.

To configure an open GNE network, you can provision RS-DCC, MS-DCC, and GCC terminations to include a far-end, non-ONS node using either the default IP address of 0.0.0.0 or a specified IP address. You provision a far-end, non-ONS node by checking the "Far End is Foreign" check box during RS-DCC, MS-DCC, and GCC creation. The default 0.0.0.0 IP address allows the far-end, non-ONS node to provide the IP address; if you set an IP address other than 0.0.0.0, a link is established only if the far-end node identifies itself with that IP address, providing an extra level of security.

By default, the proxy server only allows connections to discovered ONS peers and the firewall blocks all IP traffic between the DCC network and LAN. You can, however, provision proxy tunnels to allow up to 12 additional destinations for SOCKS version 5 connections to non-ONS nodes. You can also provision firewall tunnels to allow up to 12 additional destinations for direct IP connectivity between the DCC network and LAN. Proxy and firewall tunnels include both a source and destination subnet. The connection must originate within the source subnet and terminate within the destination subnet before either the SOCKS connection or IP packet flow is allowed.

To set up proxy and firewall subnets in CTC, use the Provisioning > Network > Proxy and Firewalls subtabs. The availability of proxy and/or firewall tunnels depends on the network access settings of the node:

- If the node is configured with the proxy server enabled in GNE or ENE mode, you must set up a proxy tunnel and/or a firewall tunnel.
- If the node is configured with the proxy server enabled in proxy-only mode, you can set up proxy tunnels. Firewall tunnels are not allowed.
- If the node is configured with the proxy server disabled, neither proxy tunnels or firewall tunnels are allowed.

Figure 13-18 shows an example of a foreign node connected to the DCC network. Proxy and firewall tunnels are useful in this example because the GNE would otherwise block IP access between the PC and the foreign node.

Figure 13-18 Proxy and Firewall Tunnels for Foreign Terminations

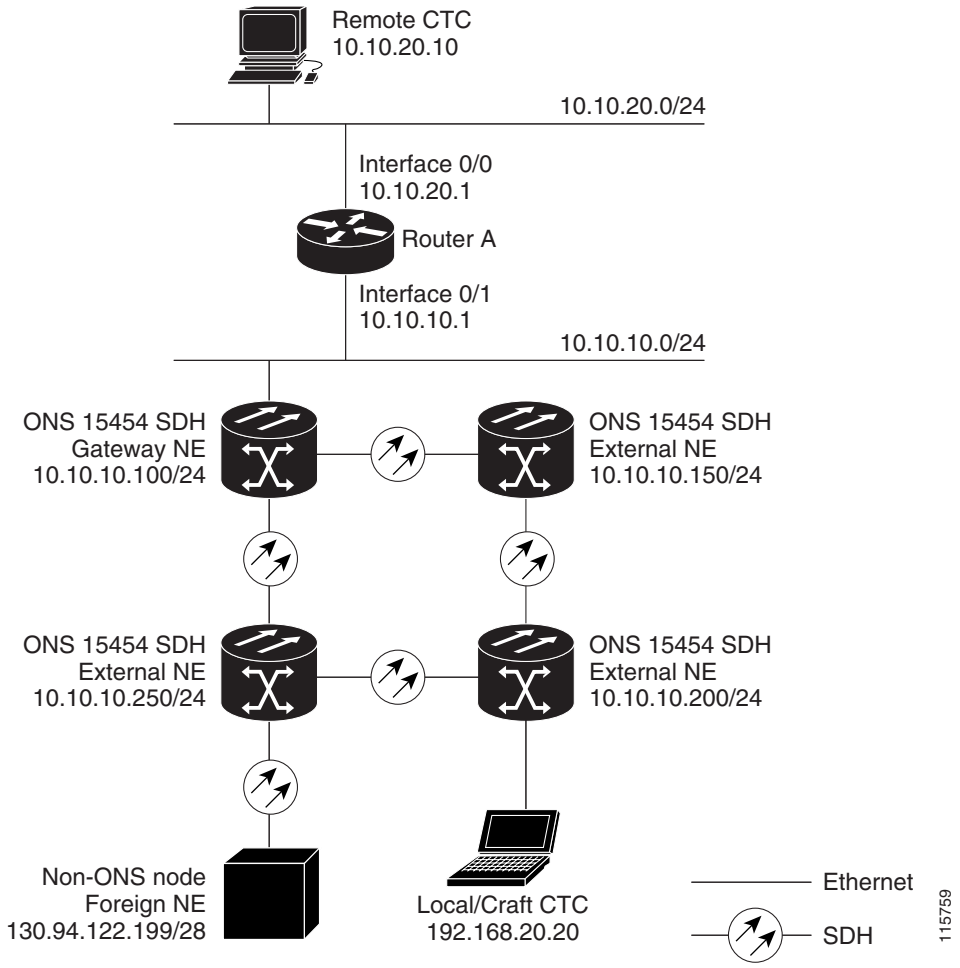
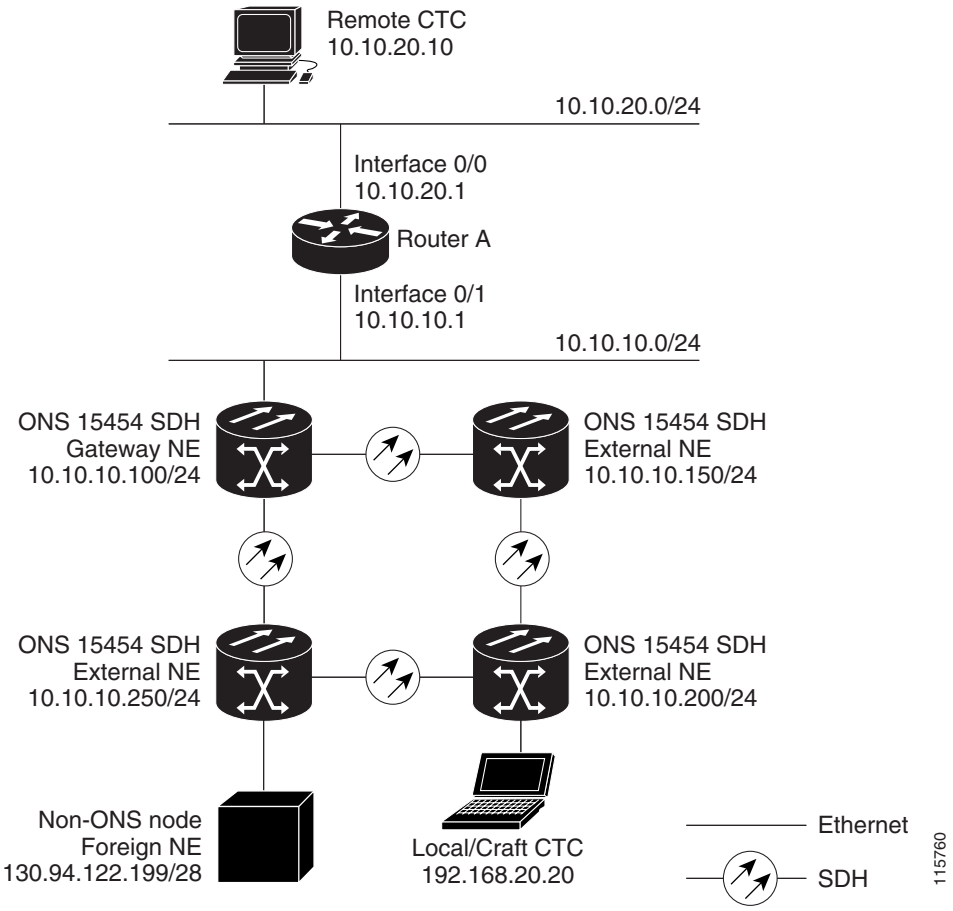


Figure 13-19 shows a remote node connected to an ENE Ethernet port. Proxy and firewall tunnels are useful in this example because the GNE would otherwise block IP access between the PC and foreign node. This configuration also requires a firewall tunnel on the ENE.

Figure 13-19 Foreign Node Connection to an ENE Ethernet Port



13.7 TCP/IP and OSI Networking

ONS 15454 DCN communication is based on the TCP/IP protocol suite. However, ONS 15454 SDH nodes can also be networked with equipment that uses the OSI protocol suite. While TCP/IP and OSI protocols are not directly compatible, they do have the same objectives and occupy similar layers of the OSI reference model. Table 13-10 shows the protocols and mediation processes that are involved when TCP/IP-based NEs are networked with OSI-based NEs.

Table 13-10 TCP/IP and OSI Protocols

OSI Model	IP Protocols	OSI Protocols		IP-OSI Mediation
Layer 7 Application	• TL1 • FTP • HTTP • Telnet • IIOP	• TARP[1]	• TL1 (over OSI) • FTAM[2] • ACSE[3]	• T–TD[4] • FT–TD[5]
Layer 6 Presentation			• PST[6]	
Layer 5 Session			• Session	
Layer 4 Transport	• TCP • UDP		• TP (Transport) Class 4	• IP-over-CLNS[7] tunnels
Layer 3 Network	• IP • OSPF	• CLNP[8] • ES-IS[9] • IS-IS[10]		
Layer 2 Data link	• PPP	• PPP • LAP-D[11]		
Layer 1 Physical	DCC, LAN, fiber, electrical	DCC, LAN, fiber, electrical		

1. TARP = TID Address Resolution Protocol
2. FTAM = File Transfer and Access Management
3. ACSE = association-control service element
4. T–TD = TL1–Translation Device
5. FT–TD = File Transfer—Translation Device
6. PST = Presentation layer
7. CLNS = Connectionless Network Layer Service
8. CLNP = Connectionless Network Layer Protocol
9. ES-IS = End System-to-Intermediate System
10. IS-IS = Intermediate System-to-Intermediate System
11. LAP-D = Link Access Protocol on the D Channel

13.7.1 Point-to-Point Protocol

PPP is a data link (Layer 2) encapsulation protocol that transports datagrams over point-to-point links. Although PPP was developed to transport IP traffic, it can carry other protocols including the OSI CLNP. PPP components used in the transport of OSI include:

- High-level data link control (HDLC)—Performs the datagram encapsulation for transport across point-to-point links.
- Link control protocol (LCP)—Establishes, configures, and tests the point-to-point connections.

CTC automatically enables IP over PPP whenever you create an RS-DCC or MS-DCC. The RS-DCC or MS-DCC can be provisioned to support OSI over PPP.

13.7.2 Link Access Protocol on the D Channel

LAP-D is a data link protocol used in the OSI protocol stack. LAP-D is assigned when you provision an ONS 15454 SDH RS-DCC as OSI-only. Provisionable LAP-D parameters include:

- Transfer Service—One of the following transfer services must be assigned:
  - Acknowledged Information Transfer Service (AITS)—(Default) Does not exchange data until a logical connection between two LAP-D users is established. This service provides reliable data transfer, flow control, and error control mechanisms.
  - Unacknowledged Information Transfer Service (UITS)—Transfers frames containing user data with no acknowledgement. The service does not guarantee that the data presented by one user will be delivered to another user, nor does it inform the user if the delivery attempt fails. It does not provide any flow control or error control mechanisms.
- Mode—LAP-D is set to either Network or User mode. This parameter sets the LAP-D frame command/response (C/R) value, which indicates whether the frame is a command or a response.
- Maximum transmission unit (MTU)—The LAP-D N201 parameter sets the maximum number of octets in a LAP-D information frame. The range is 512 to 1500 octets.

Note The MTU must be the same size for all NEs on the network.

- Transmission Timers—The following LAP-D timers can be provisioned:
  - The T200 timer sets the timeout period for initiating retries or declaring failures.
  - The T203 timer provisions the maximum time between frame exchanges, that is, the trigger for transmission of the LAP-D “keep-alive” Receive Ready (RR) frames.

Fixed values are assigned to the following LAP-D parameters:

- Terminal Endpoint Identifier (TEI)—A fixed value of 0 is assigned.
- Service Access Point Identifier (SAPI)—A fixed value of 62 is assigned.
- N200 supervisory frame retransmissions—A fixed value of 3 is assigned.

13.7.3 OSI Connectionless Network Service

OSI connectionless network service is implemented by using the Connectionless Network Protocol (CLNP) and Connectionless Network Service (CLNS). CLNP and CLNS are described in the ISO 8473 standard. CLNS provides network layer services to the transport layer through CLNP. CLNS does not perform connection setup or termination because paths are determined independently for each packet that is transmitted through a network. CLNS relies on transport layer protocols to perform error detection and correction.

CLNP is an OSI network layer protocol that carries upper-layer data and error indications over connectionless links. CLNP provides the interface between the CLNS and upper layers. CLNP performs many of the same services for the transport layer as IP. The CLNP datagram is very similar to the IP datagram. It provides mechanisms for fragmentation (data unit identification, fragment/total length, and offset). Like IP, a checksum computed on the CLNP header verifies that the information used to process the CLNP datagram is transmitted correctly, and a lifetime control mechanism (Time to Live) limits the amount of time a datagram is allowed to remain in the system.

CLNP uses network service access points (NSAPs) to identify network devices. The CLNP source and destination addresses are NSAPs. In addition, CLNP uses a network element title (NET) to identify a network-entity in an end system (ES) or intermediate system (IS). NETs are allocated from the same name space as NSAP addresses. Whether an address is an NSAP address or a NET depends on the network selector value in the NSAP.

The ONS 15454 SDH supports the ISO Data Country Code (ISO-DCC) NSAP address format as specified in ISO 8348. The NSAP address is divided into an initial domain part (IDP) and a domain-specific part (DSP). NSAP fields are shown in Table 13-11. NSAP field values are in hexadecimal format. All NSAPs are editable. Shorter NSAPs can be used. However NSAPs for all NEs residing within the same OSI network area usually have the same NSAP format.

Table 13-11 NSAP Fields

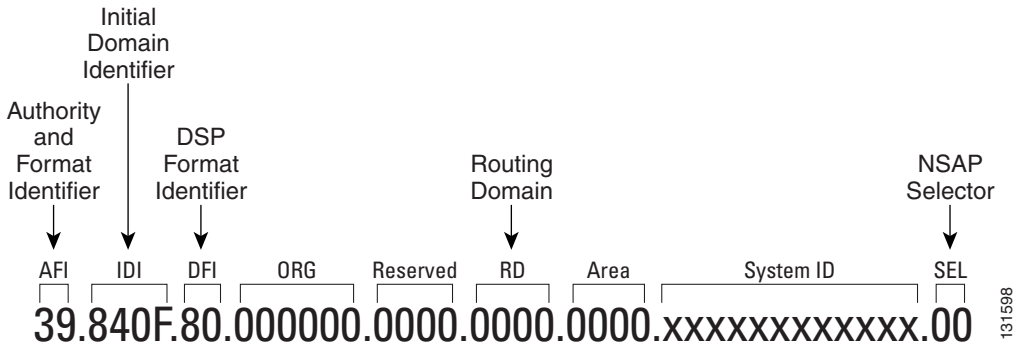
Field	Definition	Description
IDP		
AFI	Authority and format identifier	Specifies the NSAP address format. The initial value is 39 for the ISO-DCC address format.
IDI	Initial domain identifier	Specifies the country code. The initial value is 840F, the United States country code padded with an F.
DSP		
DFI	DSP format identifier	Specifies the DSP format. The initial value is 80, indicating the DSP format follows American National Standards Institute (ANSI) standards.
ORG	Organization	Organization identifier. The initial value is 000000.
Reserved	Reserved	Reserved NSAP field. The Reserved field is normally all zeros (0000).
RD	Routing domain	Defines the routing domain. The initial value is 0000.
AREA	Area	Identifies the OSI routing area to which the node belongs. The initial value is 0000.

Table 13-11 NSAP Fields (continued)

Field	Definition	Description
System	System identifier	The ONS 15454 SDH system identifier is set to its IEEE 802.3 MAC address. Each ONS 15454 SDH supports three OSI virtual routers. Each router NSAP system identifier is the ONS 15454 SDH IEEE 802.3 MAC address + *n*, where *n* = 0 to 2. For the primary virtual router, *n* = 0.
SEL	Selector	The selector field directs the protocol data units (PDUs) to the correct destination using the CLNP network layer service. Selector values supported by the ONS 15454 SDH include: • 00—Network Entity Title (NET). Used to exchange PDUs in the ES-IS and IS-IS routing exchange protocols. (See the "13.7.4.1 End System-to-Intermediate System Protocol" section on page 13-36, and "13.7.4.2 Intermediate System-to-Intermediate System" section on page 13-36.) • 1D—Selector for Transport Class 4 (and for FTAM and TL1 applications (Telcordia GR-253-CORE standard) • AF—Selector for the TARP protocol (Telcordia GR-253-CORE standard) • 2F—Selector for the GRE IP-over-CLNS tunnel (ITU/RFC standard) • CC—Selector for the Cisco IP-over-CLNS tunnels (Cisco specific) • E0—Selector for the OSI ping application (Cisco specific) NSELs are only advertised when the node is configured as an ES. They are not advertised when a node is configured as an IS. Tunnel NSELs are not advertised until a tunnel is created.

Figure 13-20 shows the ISO-DCC NSAP address with the default values delivered with the ONS 15454 SDH. The System ID is automatically populated with the node MAC address.

Figure 13-20 ISO-DCC NSAP Address



The ONS 15454 SDH main NSAP address is shown on the node view Provisioning > OSI > Main Setup subtab. This address is also the Router 1 primary manual area address, which is viewed and edited on Provisioning > OSI > Routers subtab. See the "13.7.7 OSI Virtual Routers" section on page 13-41 for information about the OSI router and manual area addresses in CTC.

13.7.4 OSI Routing

OSI architecture includes ESs and ISs. The OSI routing scheme includes:

- A set of routing protocols that allow ESs and ISs to collect and distribute the information necessary to determine routes. Protocols include the ES-IS and IS-IS protocols. ES-IS routing establishes connectivity among ESs and ISs attached to the same (single) subnetwork.
- A routing information base (RIB) containing this information, from which routes between ESs can be computed. The RIB consists of a table of entries that identify a destination (for example, an NSAP), the subnetwork over which packets should be forwarded to reach that destination, and a routing metric. The routing metric communicates characteristics of the route (such as delay properties or expected error rate) that are used to evaluate the suitability of a route compared to another route with different properties, for transporting a particular packet or class of packets.
- A routing algorithm, Shortest Path First (SPF), that uses information contained in the RIB to derive routes between ESs.

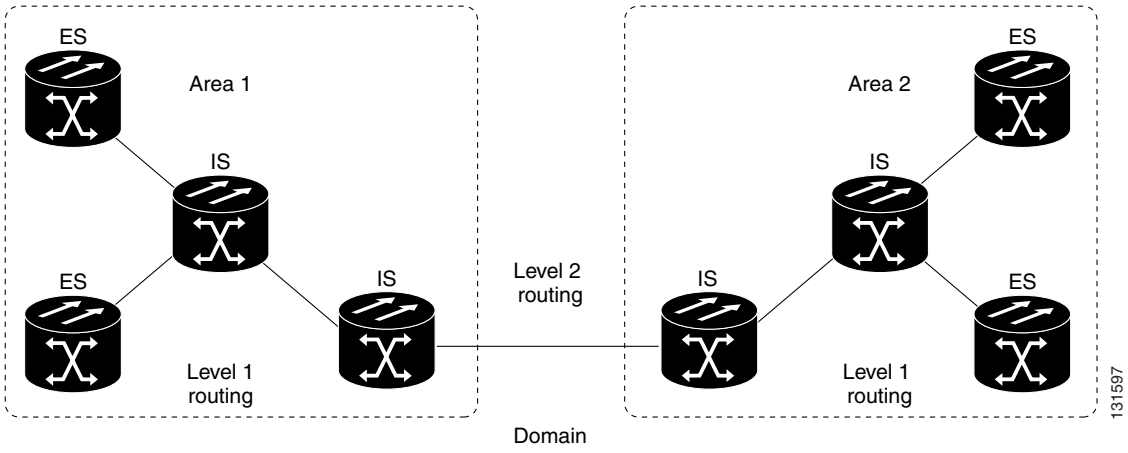
In OSI networking, discovery is based on announcements. An ES uses the ES-IS protocol end system hello (ESH) message to announce its presence to ISs and ESs connected to the same network. Any ES or IS that is listening for ESHs gets a copy. ISs store the NSAP address and the corresponding subnetwork address pair in routing tables. ESs might store the address, or they might wait to be informed by ISs when they need such information.

An IS composes intermediate system hello (ISH) messages to announce its configuration information to ISs and ESs that are connected to the same broadcast subnetwork. Like the ESHs, the ISH contains the addressing information for the IS (the NET and the subnetwork point-of-attachment address [SNPA]) and a holding time. ISHs might also communicate a suggested ES configuration time recommending a configuration timer to ESs.

The exchange of ISHs is called neighbor greeting or initialization. Each router learns about the other routers with which they share direct connectivity. After the initialization, each router constructs a link-state packet (LSP). The LSP contains a list of the names of the IS's neighbors and the cost to reach each of the neighbors. Routers then distribute the LSPs to all of the other routers. When all LSPs are propagated to all routers, each router has a complete map of the network topology (in the form of LSPs). Routers use the LSPs and the SPF algorithm to compute routes to every destination in the network.

OSI networks are divided into areas and domains. An area is a group of contiguous networks and attached hosts that is designated as an area by a network administrator. A domain is a collection of connected areas. Routing domains provide full connectivity to all ESs within them. Routing within the same area is known as Level 1 routing. Routing between two areas is known as Level 2 routing. LSPs that are exchanged within a Level 1 area are called L1 LSPs. LSPs that are exchanged across Level 2 areas are called L2 LSPs. Figure 13-21 shows an example of Level 1 and Level 2 routing.

Figure 13-21 Level 1 and Level 2 OSI Routing



When you provision an ONS 15454 SDH for a network with NEs that use both the TCP/IP and OSI protocol stacks, you will provision it as one of the following:

- End System—The ONS 15454 SDH performs OSI ES functions and relies upon an IS for communication with nodes that reside within its OSI area.
- Intermediate System Level 1—The ONS 15454 SDH performs OSI IS functions. It communicates with IS and ES nodes that reside within its OSI area. It depends upon an IS L1/L2 node to communicate with IS and ES nodes that reside outside its OSI area.
- Intermediate System Level 1/Level 2—The ONS 15454 SDH performs IS functions. It communicates with IS and ES nodes that reside within its OSI area. It also communicates with IS L1/L2 nodes that reside in other OSI areas. This option should not be provisioned unless the node is connected to another IS L1/L2 node that resides in a different OSI area. The node must also be connected to all nodes within its area that are provisioned as IS L1/L2.

13.7.4.1 End System-to-Intermediate System Protocol

ES-IS is an OSI protocol that defines how ESs (hosts) and ISs (routers) learn about each other. ES-IS configuration information is transmitted at regular intervals through the ES and IS hello messages. The hello messages contain the subnetwork and network layer addresses of the systems that generate them.

The ES-IS configuration protocol communicates both OSI network layer addresses and OSI subnetwork addresses. OSI network layer addresses identify either the NSAP, which is the interface between OSI Layer 3 and Layer 4, or the NET, which is the network layer entity in an OSI IS. OSI SNPAs are the points at which an ES or IS is physically attached to a subnetwork. The SNPA address uniquely identifies each system attached to the subnetwork. In an Ethernet network, for example, the SNPA is the 48-bit MAC address. Part of the configuration information transmitted by ES-IS is the NSAP-to-SNPA or NET-to-SNPA mapping.

13.7.4.2 Intermediate System-to-Intermediate System

IS-IS is an OSI link-state hierarchical routing protocol that floods the network with link-state information to build a complete, consistent picture of a network topology. IS-IS distinguishes between Level 1 and Level 2 ISs. Level 1 ISs communicate with other Level 1 ISs in the same area. Level 2 ISs

route between Level 1 areas and form an intradomain routing backbone. Level 1 ISs need to know only how to get to the nearest Level 2 IS. The backbone routing protocol can change without impacting the intra-area routing protocol.

OSI routing begins when the ESs discover the nearest IS by listening to ISH packets. When an ES wants to send a packet to another ES, it sends the packet to one of the ISs on its directly attached network. The router then looks up the destination address and forwards the packet along the best route. If the destination ES is on the same subnetwork, the local IS knows this from listening to ESHs and forwards the packet appropriately. The IS also might provide a redirect (RD) message back to the source to tell it that a more direct route is available. If the destination address is an ES on another subnetwork in the same area, the IS knows the correct route and forwards the packet appropriately. If the destination address is an ES in another area, the Level 1 IS sends the packet to the nearest Level 2 IS. Forwarding through Level 2 ISs continues until the packet reaches a Level 2 IS in the destination area. Within the destination area, the ISs forward the packet along the best path until the destination ES is reached.

Link-state update messages help ISs learn about the network topology. Each IS generates an update specifying the ESs and ISs to which it is connected, as well as the associated metrics. The update is then sent to all neighboring ISs, which forward (flood) it to their neighbors, and so on. (Sequence numbers terminate the flood and distinguish old updates from new ones.) Using these updates, each IS can build a complete topology of the network. When the topology changes, new updates are sent.

IS-IS uses a single required default metric with a maximum path value of 1024. The metric is arbitrary and typically is assigned by a network administrator. Any single link can have a maximum value of 64, and path links are calculated by summing link values. Maximum metric values were set at these levels to provide the granularity to support various link types while at the same time ensuring that the shortest-path algorithm used for route computation is reasonably efficient. Three optional IS-IS metrics (costs)—delay, expense, and error—are not supported by the ONS 15454 SDH. IS-IS maintains a mapping of the metrics to the quality of service (QoS) option in the CLNP packet header. IS-IS uses the mappings to compute routes through the internetwork.

13.7.5 TARP

TARP is used when TL1 target identifiers (TIDs) must be translated to NSAP addresses. The TID-to-NSAP translation occurs by mapping TIDs to the NETs, then deriving NSAPs from the NETs by using the NSAP selector values (Table 13-11 on page 13-33).

TARP uses a selective PDU propagation methodology in conjunction with a distributed database (that resides within the NEs) of TID-to-NET mappings. TARP allows NEs to translate between TID and NET by automatically exchanging mapping information with other NEs. The TARP PDU is carried by the standard CLNP Data PDU. TARP PDU fields are shown in Table 13-12.

Table 13-12 TARP PDU Fields

Field	Abbreviation	Size (bytes)	Description
TARP Lifetime	tar-lif	2	The TARP time-to-live in hops.
TARP Sequence Number	tar-seq	2	The TARP sequence number used for loop detection.
Protocol Address Type	tar-pro	1	Used to identify the type of protocol address that the TID must be mapped to. The value FE is used to identify the CLNP address type.
TARP Type Code	tar-tcd	1	Used to identify the TARP type of PDU. Five TARP types, shown in Table 13-13, are defined.

Table 13-12 TARP PDU Fields (continued)

Field	Abbreviation	Size (bytes)	Description
TID Target Length	tar-tln	1	The number of octets in the tar-ttg field.
TID Originator Length	tar-oln	1	The number of octets in the tar-tor field.
Protocol Address Length	tar-pln	1	The number of octets in the tar-por field.
TID of Target	tar-ttg	*n* = 0, 1, 2...	TID value for the target NE.
TID of Originator	tar-tor	*n* = 0, 1, 2...	TID value of the TARP PDU originator.
Protocol Address of Originator	tar-por	*n* = 0, 1, 2...	Protocol address (for the protocol type identified in the tar-pro field) of the TARP PDU originator. When the tar-pro field is set to FE (hex), tar-por will contain a CLNP address (that is, the NET).

Table 13-13 shows the TARP PDUs types that govern TARP interaction and routing.

Table 13-13 TARP PDU Types

Type	Description	Procedure
1	Sent when a device has a TID for which it has no matching NSAP.	After an NE originates a TARP Type 1 PDU, the PDU is sent to all adjacencies within the NE's routing area.
2	Sent when a device has a TID for which it has no matching NSAP and no response was received from the Type 1 PDU.	After an NE originates a TARP Type 2 PDU, the PDU is sent to all Level 1 and Level 2 neighbors.
3	Sent as a response to Type 1, Type 2, or Type 5 PDUs.	After a TARP Request (Type 1 or 2) PDU is received, a TARP Type 3 PDU is sent to the request originator. Type 3 PDUs do not use the TARP propagation procedures.
4	Sent as a notification when a change occurs locally, for example, a TID or NSAP change. It might also be sent when an NE initializes.	A Type 4 PDU is a notification of a TID or Protocol Address change at the NE that originates the notification. The PDU is sent to all adjacencies inside and outside the NE routing area.
5	Sent when a device needs a TID that corresponds to a specific NSAP.	When a Type 5 PDU is sent, the CLNP destination address is known, so the PDU is sent to only that address. Type 5 PDUs do not use the TARP propagation procedures.

13.7.5.1 TARP Processing

A TARP data cache (TDC) is created at each NE to facilitate TARP processing. In CTC, the TDC is displayed and managed on the node view Maintenance > OSI > TDC subtab. The TDC subtab contains the following TARP PDU fields:

- TID—TID of the originating NE (tar-tor).

- NSAP—NSAP of the originating NE.
- Type— Indicates whether the TARP PDU was created through the TARP propagation process (dynamic) or manually created (static).

Provisionable timers, shown in Table 13-14, control TARP processing.

Table 13-14 TARP Timers

Timer	Description	Default (seconds)	Range (seconds)
T1	Waiting for response to TARP Type 1 Request PDU	15	0–3600
T2	Waiting for response to TARP Type 2 Request PDU	25	0–3600
T3	Waiting for response to address resolution request	40	0–3600
T4	Timer starts when T2 expires (used during error recovery)	20	0–3600

Table 13-15 shows the main TARP processes and the general sequence of events that occurs in each process.

Table 13-15 TARP Processing Flow

Process	General TARP Flow
Find a NET that matches a TID	1. TARP checks its TDC for a match. If a match is found, TARP returns the result to the requesting application. 2. If no match is found, a TARP Type 1 PDU is generated and Timer T1 is started. 3. If Timer T1 expires before a match if found, a Type 2 PDU is generated and Timer T2 is started. 4. If Timer T2 expires before a match is found, Timer T4 is started. 5. If Timer T4 expires before a match is found, a Type 2 PDU is generated and Timer T2 is started.
Find a TID that matches a NET	A Type 5 PDU is generated. Timer T3 is used. However, if the timer expires, no error recovery procedure occurs, and a status message is provided to indicate that the TID cannot be found.
Send a notification of TID or protocol address change	TARP generates a Type 4 PDU in which the tar-ttg field contains the NE's TID value that existed prior to the change of TID or protocol address. Confirmation that other NEs successfully received the address change is not sent.

13.7.5.2 TARP Loop Detection Buffer

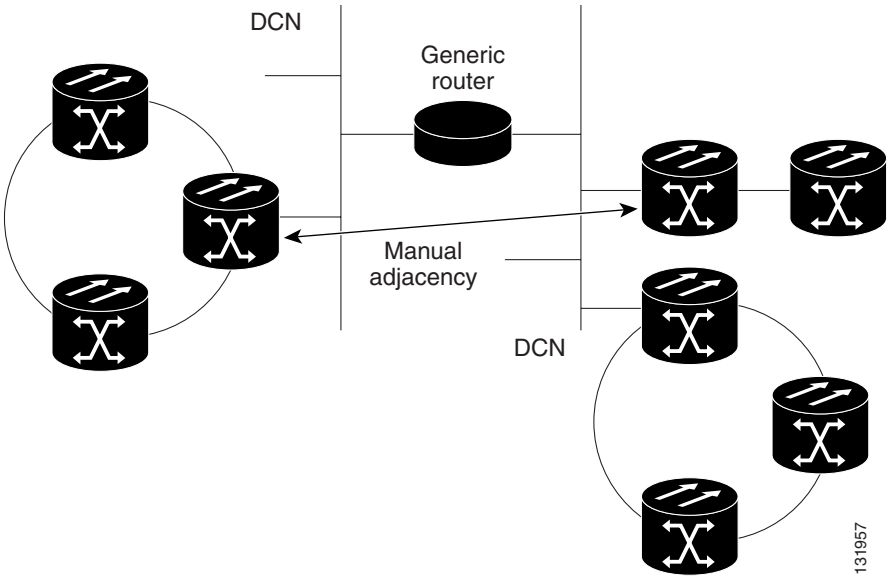
The TARP loop detection buffer (LDB) can be enabled to prevent duplicate TARP PDUs from entering the TDC. When a TARP Type 1, 2, or 4 PDU arrives, TARP checks its LDB for a NET address (tar-por) of the PDU originator match. If no match is found, TARP processes the PDU and assigns a tar-por, tar-seq (sequence) entry for the PDU to the LDB. If the tar-seq is zero, a timer associated with the LDB entry is started using the provisionable LDB entry timer on the node view OSI > TARP > Config tab. If a match exists, the tar-seq is compared to the LDB entry. If the tar-seq is not zero and is less than or equal to the LDB entry, the PDU is discarded. If the tar-seq is greater than the LDB entry, the PDU is processed

and the tar-seq field in the LDB entry is updated with the new value. The Cisco ONS 15454 SDH LDB holds approximately 500 entries. The LDB is flushed periodically based on the time set in the LDB Flush timer on the node view OSI > TARP > Config tab.

13.7.5.3 Manual TARP Adjacencies

TARP adjacencies can be manually provisioned in networks where ONS 15454 SDH nodes must communicate across routers or non-SONET NEs that lack TARP capability. In CTC, manual TARP adjacencies are provisioned on the node view Provisioning > OSI > TARP > MAT (Manual Area Table) subtab. The manual adjacency causes a TARP request to hop through the general router or non-SONET NE, as shown in Figure 13-22.

Figure 13-22 Manual TARP Adjacencies



13.7.5.4 Manual TID to NSAP Provisioning

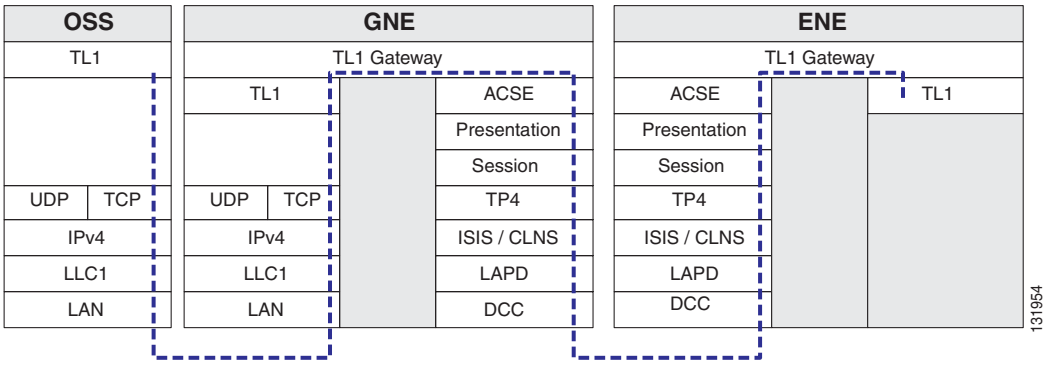
TIDs can be manually linked to NSAPs and added to the TDC. Static TDC entries are similar to static routes. For a specific TID, you force a specific NSAP. Resolution requests for that TID always return that NSAP. No TARP network propagation or instantaneous replies are involved. Static entries allow you to forward TL1 commands to NEs that do not support TARP. However, static TDC entries are not dynamically updated, so outdated entries are not removed after the TID or the NSAP changes on the target node.

13.7.6 TCP/IP and OSI Mediation

Two mediation processes facilitate TL1 networking and file transfers between NEs and ONS client computers running TCP/IP and OSI protocol suites:

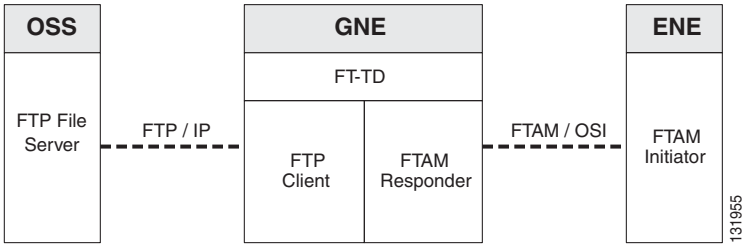
- T–TD—Performs a TL1-over-IP to TL1-over-OSI gateway mediation to enable an IP-based OSS to manage OSI-only NEs subtended from a GNE. Figure 13-23 shows the T–TD protocol flow.

Figure 13-23 T–TD Protocol Flow



- FT–TD—Performs an FTP conversion between FTAM and FTP. The FT–TD gateway entity includes an FTAM responder (server) and an FTP client, allowing FTAM initiators (clients) to store, retrieve, or delete files from an FTP server. The FT–TD gateway is unidirectional and is driven by the FTAM initiator. The FT–TD FTAM responder exchanges messages with the FTAM initiator over the full OSI stack. Figure 13-24 shows the FT–TD protocol flow.

Figure 13-24 FT–TD Protocol Flow



The ONS 15454 SDH uses FT–TD for the following file transfer processes:

- Software downloads
- Database backups and restores
- Cisco IOS configuration backups and restores for ML Series cards.

13.7.7 OSI Virtual Routers

The ONS 15454 SDH supports three OSI virtual routers. The routers are provisioned on the Provisioning > OSI > Routers tab, Each router has an editable manual area address and a unique NSAP System ID that is set to the node MAC address + *n*. For Router 1, *n* = 0. For Router 1, *n* = 1. For Router 2, *n* = 2. Each router can be enabled and connected to different OSI routing areas. However, Router 1 is the primary router, and it must be enabled before Router 2 and Router 3 can be enabled. The Router 1 manual area address and System ID create the NSAP address assigned to the node's TID. In addition, Router 1 supports OSI TARP, mediation, and tunneling functions that are not supported by Router 2 and Router 3. These include:

- TID-to-NSAP resolution
- TARP data cache
- IP-over-CLNS tunnels

- FTAM
- FT-TD
- T-TD
- LAN subnet

OSI virtual router constraints depend on the routing mode provisioned for the node. Table 13-16 shows the number of IS L1s, IS L1/L2s, and DCCs that are supported by each router. An IS L1 and IS L1/L2 support one ES per DCC subnet and up to 100 ESs per LAN subnet.

Table 13-16 OSI Virtual Router Constraints

Routing Mode	Router 1	Router 2	Router 3	IS L1 per area	IS L1/L2 per area	DCC per IS
End System	Yes	No	No	—	—	—
IS L1	Yes	Yes	Yes	250	—	40
IS L1/L2	Yes	Yes	Yes	250	50	40

Each OSI virtual router has a primary manual area address. You can also create two additional manual area addresses. These manual area addresses can be used to:

- Split up an area—Nodes within a given area can accumulate to a point that they are difficult to manage, cause excessive traffic, or threaten to exceed the usable address space for an area. Additional manual area addresses can be assigned so that you can smoothly partition a network into separate areas without disrupting service.
- Merge areas—Use transitional area addresses to merge as many as three separate areas into a single area that shares a common area address.
- Change to a different address—You might need to change an area address for a particular group of nodes. Use multiple manual area addresses to allow incoming traffic intended for an old area address to continue being routed to associated nodes.

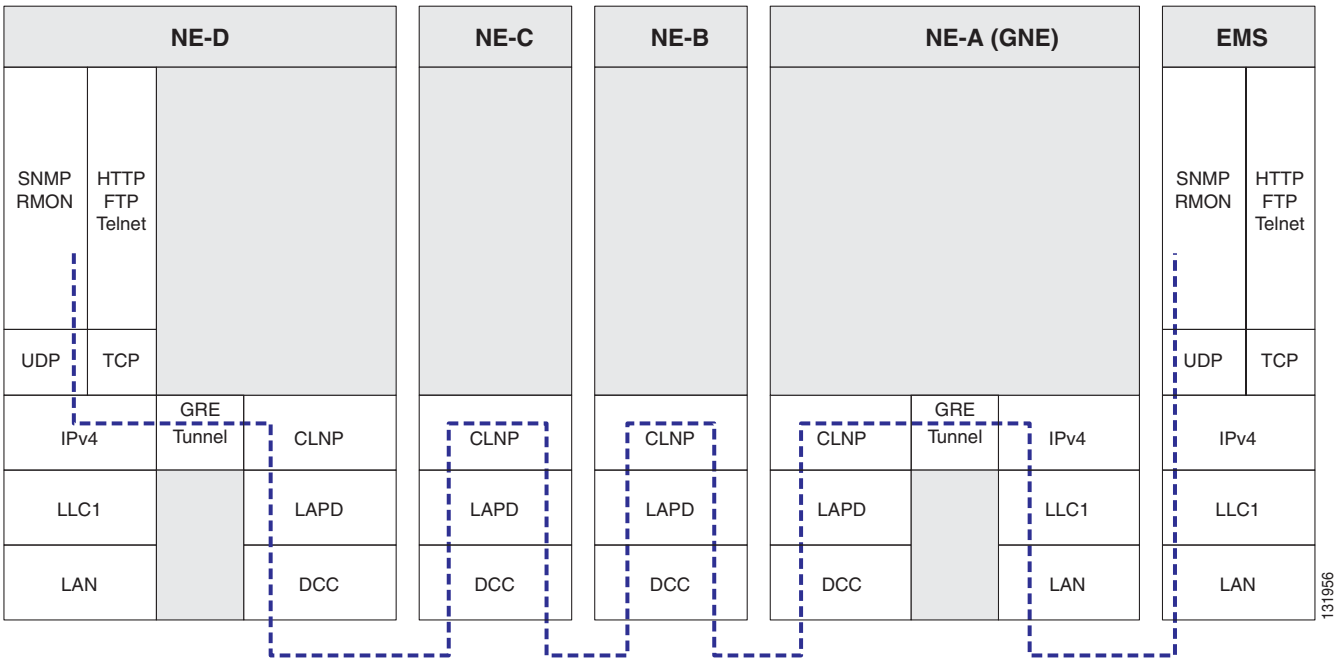
13.7.8 IP-over-CLNS Tunnels

IP-over-CLNS tunnels are used to encapsulate IP for transport across OSI NEs. The ONS 15454 SDH supports two tunnel types:

- GRE—Generic Routing Encapsulation is a tunneling protocol that encapsulates one network layer for transport across another. GRE tunnels add both a CLNS header and a GRE header to the tunnel frames. GRE tunnels are supported by Cisco routers and some other vendor NEs.
- Cisco IP—The Cisco IP tunnel directly encapsulates the IP packet with no intermediate header. Cisco IP is supported by most Cisco routers.

Figure 13-23 shows the protocol flow when an IP-over-CLNS tunnel is created through four NEs (A, B, C, and D). The tunnel ends are configured on NEs A and D, which support both IP and OSI. NEs B and C only support OSI, so they only route the OSI packets.

Figure 13-25 IP-over-CLNS Tunnel Flow



13.7.8.1 Provisioning IP-over-CLNS Tunnels

IP-over-CLNS tunnels must be carefully planned to prevent nodes from losing visibility or connectivity. Before you begin a tunnel, verify that the tunnel type, either Cisco IP or GRE, is supported by the equipment at the other end. Always verify IP and NSAP addresses. Provisioning of IP-over-CLNS tunnels in CTC is performed on the node view Provisioning > OSI > IP over CLNS Tunnels tab. For procedures, refer to the "Turn Up a Node" chapter in the *Cisco ONS 15454 SDH Procedure Guide*.

Provisioning IP-over-CLNS tunnels on Cisco routers requires the following prerequisite tasks, as well as other OSI provisioning:

- (Required) Enable IS-IS
- (Optional) Enable routing for an area on an interface
- (Optional) Assign multiple area addresses
- (Optional) Configure IS-IS interface parameters
- (Optional) Configure miscellaneous IS-IS parameters

The Cisco IOS commands used to create IP-over-CLNS tunnels (CTunnels) are shown in Table 13-17.

Table 13-17 IP-over-CLNS Tunnel IOS Commands

Step	Step	Purpose
1	Router (config) # **interface ctunnel** *interface-number*	Creates a virtual interface to transport IP over a CLNS tunnel and enters interface configuration mode. The interface number must be unique for each CTunnel interface.
2	Router (config-if # **ctunnel destination** *remote-nsap-address*	Configures the destination parameter for the CTunnel. Specifies the destination NSAP1 address of the CTunnel, where the IP packets are extracted.
3	Router (config-if) # **ip address** *ip-address mask*	Sets the primary or secondary IP address for an interface.

If you are provisioning an IP-over-CLNS tunnel on a Cisco router, always follow procedures provided in the Cisco IOS documentation for the router you are provisioning. For information about ISO CLNS provisioning including IP-over-CLNS tunnels, see the "Configuring ISO CLNS" chapter in the *Cisco IOS Apollo Domain, Banyon VINES, DECnet, ISO CLNS, and XNS Configuration Guide*.

13.7.8.2 IP-over-CLNS Tunnel Scenario 1: ONS Node to Other Vendor GNE

Figure 13-26 shows an IP-over-CLNS tunnel created from an ONS node to another vendor GNE. The other vendor NE has an IP connection to an IP DCN to which a CTC computer is attached. An OSI-only (LAP-D) RS-DCC and a GRE tunnel are created between the ONS NE 1 to the other vender GNE.

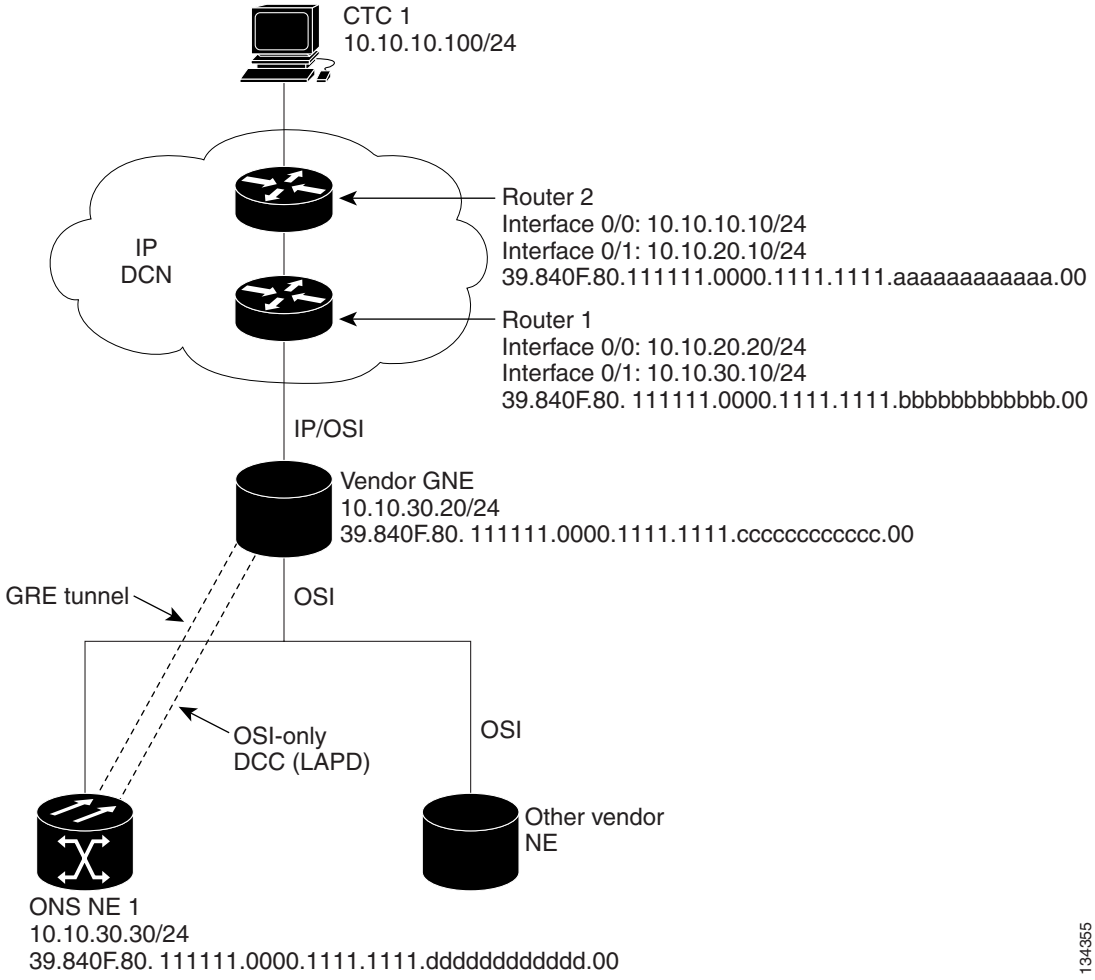
IP-over-CLNS tunnel provisioning on ONS NE 1:

- Destination: 10.10.10.100 (CTC 1)
- Mask: 255.255.255.255 for host route (CTC 1 only), or 255.255.255.0 for subnet route (all CTC computers residing on the 10.10.10.0 subnet)
- NSAP: 39.840F.80.1111.0000.1111.1111.ccccccccccc.00 (other vendor GNE)
- Metric: 110
- Tunnel Type: GRE

IP-over-CLNS tunnel provisioning on the other vender GNE:

- Destination: 10.20.30.30 (ONS NE 1)
- Mask: 255.255.255.255 for host route (ONS NE 1 only), or 255.255.255.0 for subnet route (all ONS nodes residing on the 10.30.30.0 subnet)
- NSAP: 39.840F.80.1111.0000.1111.1111.ddddddddddd.00 (ONS NE 1)
- Metric: 110
- Tunnel Type: GRE

Figure 13-26 IP-over-CLNS Tunnel Scenario 1: ONS NE to Other Vender GNE



13.7.8.3 IP-over-CLNS Tunnel Scenario 2: ONS Node to Router

Figure 13-27 shows an IP-over-CLNS tunnel from an ONS node to a router. The other vendor NE has an OSI connection to a router on an IP DCN, to which a CTC computer is attached. An OSI-only (LAP-D) RS-DCC is created between the ONS NE 1 and the other vender GNE. The OSI over IP tunnel can be either the Cisco IP tunnel or a GRE tunnel, depending on the tunnel types supported by the router.

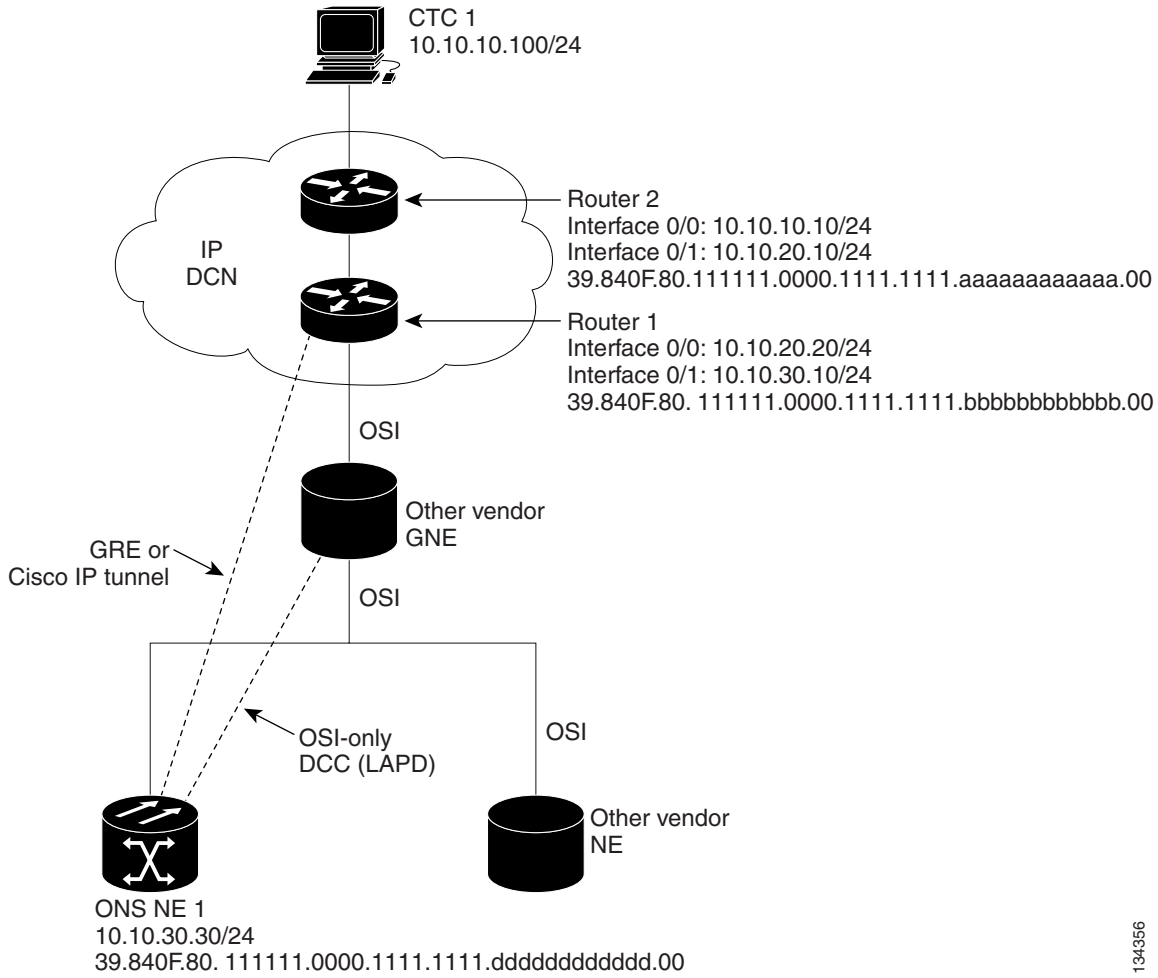
IP-over-CLNS tunnel provisioning on ONS NE 1:

- Destination: 10.10.30.10 (Router 1, Interface 0/1)
- Mask: 255.255.255.255 for host route (Router 1 only), or 255.255.255.0 for subnet route (all routers on the same subnet)
- NSAP: 39.840F.80.1111.0000.1111.1111.bbbbbbbbbbbb.00 (Router 1)
- Metric: 110
- Tunnel Type: Cisco IP

CTunnel (IP-over-CLNS) provisioning on Router 1:

```
ip routing
clns routing
interface ctunnel 102
    ip address 10.10.30.30 255.255.255.0
    ctunnel destination 39.840F.80.1111.0000.1111.1111.dddddddddddd.00
interface Ethernet0/1
    clns router isis
router isis
    net 39.840F.80.1111.0000.1111.1111.bbbbbbbbbbbb.00
```

Figure 13-27 IP-over-CLNS Tunnel Scenario 2: ONS Node to Router



13.7.8.4 IP-over-CLNS Tunnel Scenario 3: ONS Node to Router Across an OSI DCN

Figure 13-28 shows an IP-over-CLNS tunnel from an ONS node to a router across an OSI DCN. The other vendor NE has an OSI connection to an IP DCN to which a CTC computer is attached. An OSI-only (LAP-D) RS-DCC is created between the ONS NE 1 and the other vender GNE. The OSI over IP tunnel can be either the Cisco IP tunnel or a GRE tunnel, depending on the tunnel types supported by the router.

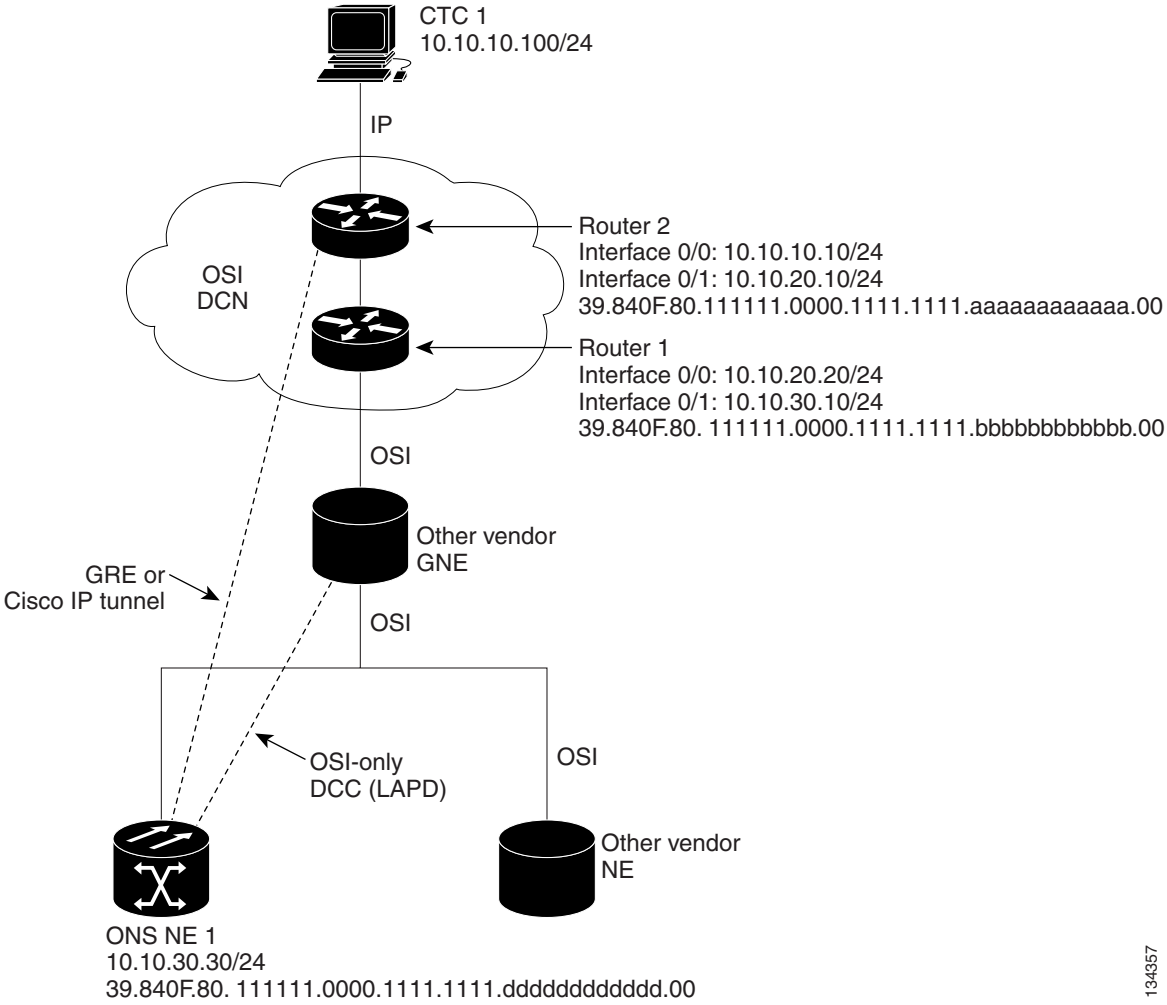
IP-over-CLNS tunnel provisioning on ONS NE 1:

- Destination: Router 2 IP address
- Mask: 255.255.255.255 for host route (CTC 1 only), or 255.255.255.0 for subnet route (all CTC computers on the same subnet)
- NSAP: Other vender GNE NSAP address
- Metric: 110
- Tunnel Type: Cisco IP

IP over OSI tunnel provisioning on Router 2 (sample Cisco IOS provisioning):

```
ip routing
clns routing
interface ctunnel 102
    ip address 10.10.30.30 255.255.255.0
    ctunnel destination 39.840F.80.1111.0000.1111.1111.ddddddddddd.00
interface Ethernet0/1
    clns router isis
router isis
    net 39.840F.80.1111.0000.1111.1111.aaaaaaaaaaa.00
```

Figure 13-28 IP-over-CLNS Tunnel Scenario 3: ONS Node to Router Across an OSI DCN



13.7.9 OSI/IP Networking Scenarios

The following eight scenarios show examples of ONS 15454 SDH nodes in networks with OSI-based NEs. The scenarios show ONS 15454 SDH nodes in a variety of roles. The scenarios assume the following:

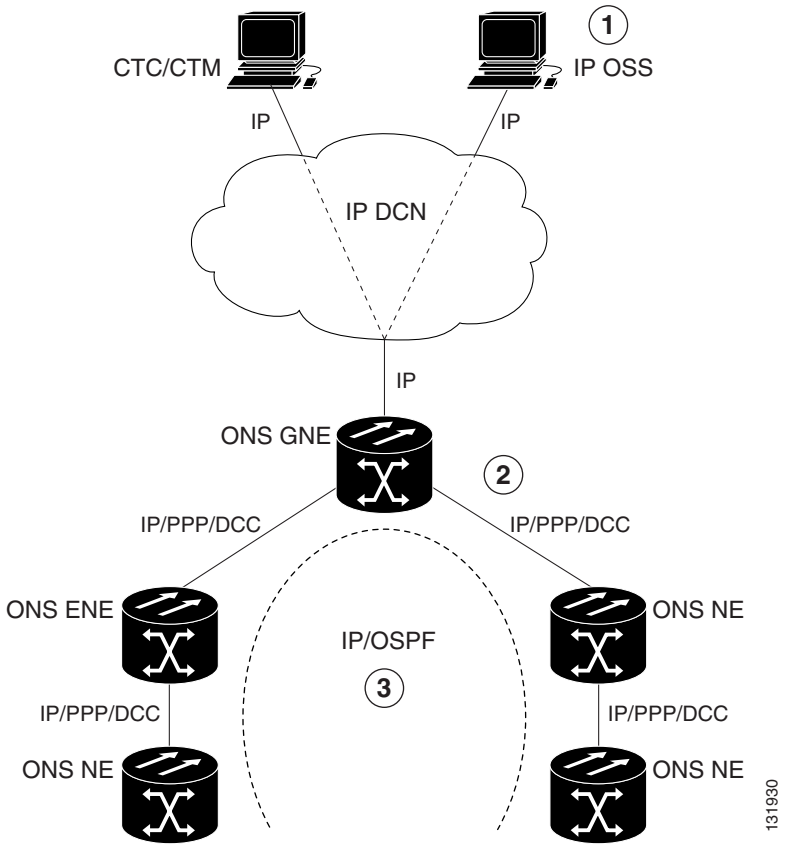
- ONS 15454 SDH NEs are configured as dual OSI and IP nodes with both IP and NSAP addresses. They run both OSPF and OSI (IS-IS or ES-IS) routing protocols as "Ships-In-The-Night," with no route redistribution.
- ONS 15454 SDH NEs run TARP, which allows them to resolve a TL1 TID to a NSAP address. A TID might resolve to both an IP and an NSAP address when the destination TID is an ONS 15454 SDH NE that has both IP and NSAP address.
- DCC links between ONS 15454 SDH NEs and OSI-only NEs run the full OSI stack over LAP-D, which includes IS-IS, ES-IS, and TARP.
- DCC links between ONS 15454 SDH NEs run the full OSI stack and IP (OSPF) over PPP.

- All ONS 15454 SDH NEs participating in an OSI network run OSI over PPP between themselves. This is needed so that other vendor GNEs can route TL1 commands to all ONS 15454 SDH NEs participating in the OSI network.

13.7.9.1 OSI/IP Scenario 1: IP OSS, IP DCN, ONS GNE, IP DCC, and ONS ENE

Figure 13-29 shows OSI/IP Scenario 1, the current ONS 15454 SDH IP-based implementation, with an IP DCN, IP-over-PPP DCC, and OSPF routing.

Figure 13-29 OSI/IP Scenario 1: IP OSS, IP DCN, ONS GNE, IP DCC, and ONS ENE

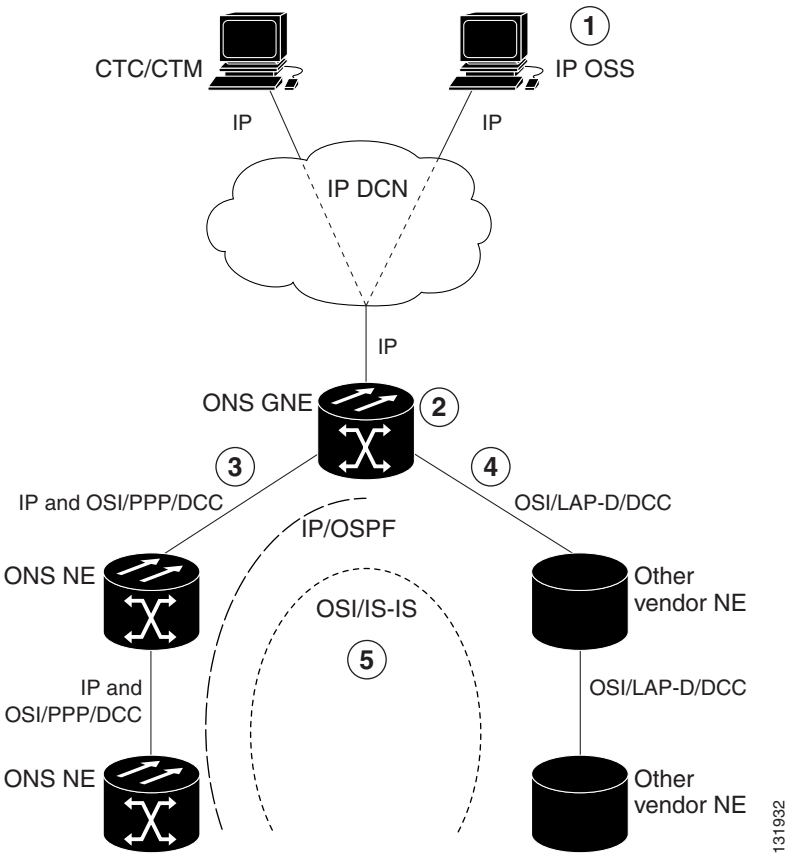


1	IP OSS manages ONS 15454 SDH using TL1 and FTP.
2	DCCs carry IP over the PPP protocol.
3	The ONS 15454 SDH network is managed by IP over OSPF.

13.7.9.2 OSI/IP Scenario 2: IP OSS, IP DCN, ONS GNE, OSI DCC, and Other Vendor ENE

OSI/IP Scenario 2 (Figure 13-30) shows an ONS 15454 SDH GNE in a multivendor OSI network. Both the ONS 15454 SDH GNE and the other vendor NEs are managed by an IP OSS using TL1 and FTP. The ONS 15454 SDH is also managed by CTC and Cisco Transport Manager (CTM). Because the other vendor NE only supports TL1 and FTAM over the full OSI stack, the ONS 15454 SDH GNE provides T–TD and FT–TD mediation to convert TL1/IP to TL1/OSI and FTAM/OSI to FTP/IP.

Figure 13-30 OSI/IP Scenario 2: IP OSS, IP DCN, ONS GNE, OSI DCC, and Other Vendor ENE



1	The IP OSS manages ONS 15454 SDH and other vendor NEs using TL1 and FTP.
2	The ONS 15454 SDH GNE performs mediation for other vendor NEs.
3	DCCs between the ONS 15454 SDH GNE and ONS 15454 SDH NEs are provisioned for IP and OSI over PPP.
4	DCCs between the ONS 15454 SDH GNE and other vendor NEs are provisioned for OSI over LAP-D.
5	The ONS 15454 SDH and the other vendor NE network include IP over OSPF and OSI over the IS-IS protocol.

The ONS 15454 SDH GNE routes TL1 traffic to the correct NE by resolving the TL1 TID to either an IP or NSAP address. For TL1 traffic to other vendor NEs (OSI-only nodes), the TID is resolved to an NSAP address. The ONS 15454 SDH GNE passes the TL1 to the mediation function, which encapsulates it over the full OSI stack and routes it to the destination using the IS-IS protocol.

For TL1 traffic to ONS 15454 SDH NEs, the TID is resolved to both an IP and an NSAP address. The ONS 15454 SDH GNE follows the current TL1 processing model and forwards the request to the destination NE using the TCP/IP stack and OSPF routing.

OSS-initiated software downloads consist of two parts: the OSS to destination NE TL1 download request and the file transfer. The TL1 request is handled the same as described in the previous paragraph. The ONS 15454 SDH NEs use FTP for file transfers. OSI-only NEs use FTAM to perform file transfers. The FTAM protocol is carried over OSI between the OSI NE and the ONS 15454 SDH GNE. The GNE mediation translates between FTAM to FTP.

13.7.9.3 OSI/IP Scenario 3: IP OSS, IP DCN, Other Vendor GNE, OSI DCC, and ONS ENE

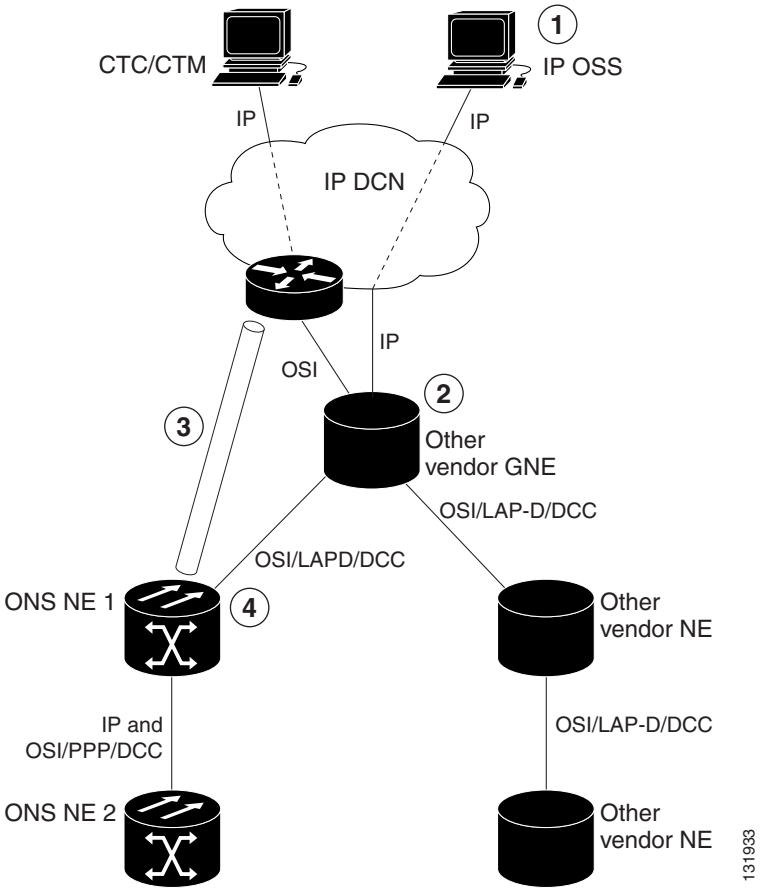
In OSI/IP Scenario 3 (Figure 13-31), all TL1 traffic between the OSS and GNE is exchanged over the IP DCN. TL1 traffic targeted for the GNE is processed locally. All other TL1 traffic is forwarded to the OSI stack, which performs IP-to-OSI TL1 translation. The TL1 is encapsulated in the full OSI stack and sent to the target NE over the DCC. The GNE can route to any node within the IS-IS domain because all NEs, ONS 15454 SDH and non-ONS 15454 SDH, have NSAP addresses and support IS-IS routing.

TL1 traffic received by an ONS 15454 SDH NE and not addressed to its NSAP address is forwarded by IS-IS routing to the correct destination. TL1 traffic received by an ONS 15454 SDH NE and addressed to its NSAP is sent up the OSI stack to the mediation function, which extracts the TL1 and passes it to the ONS 15454 SDH TL1 processor.

An OSS initiated software download includes the OSS to destination node TL1 download request and the file transfer. The TL1 request is handled as described in the previous paragraph. The target node uses FTAM for file transfers because the GNE does not support IP on the DCC and cannot forward FTP. The ONS 15454 SDH NEs therefore must support an FTAM client and initiate file transfer using FTAM when subtended to an OSI GNE.

In this scenario, the GNE has both IP and OSI DCN connections. The GNE only supports TL1 and FTP over IP. Both are translated and then carried over OSI to the destination ENE (ONS 15454 SDH or OSI-only NE). All other IP traffic is discarded by the GNE. The CTC/CTM IP traffic is carried over an IP-over-OSI tunnel to an ONS 15454 SDH NE. The tunnel is created between an external router and an ONS 15454 SDH NE. The traffic is sent to the ONS 15454 SDH terminating the tunnel. That ONS 15454 SDH then forwards the traffic over the tunnel to CTC/CTM by way of the external router.

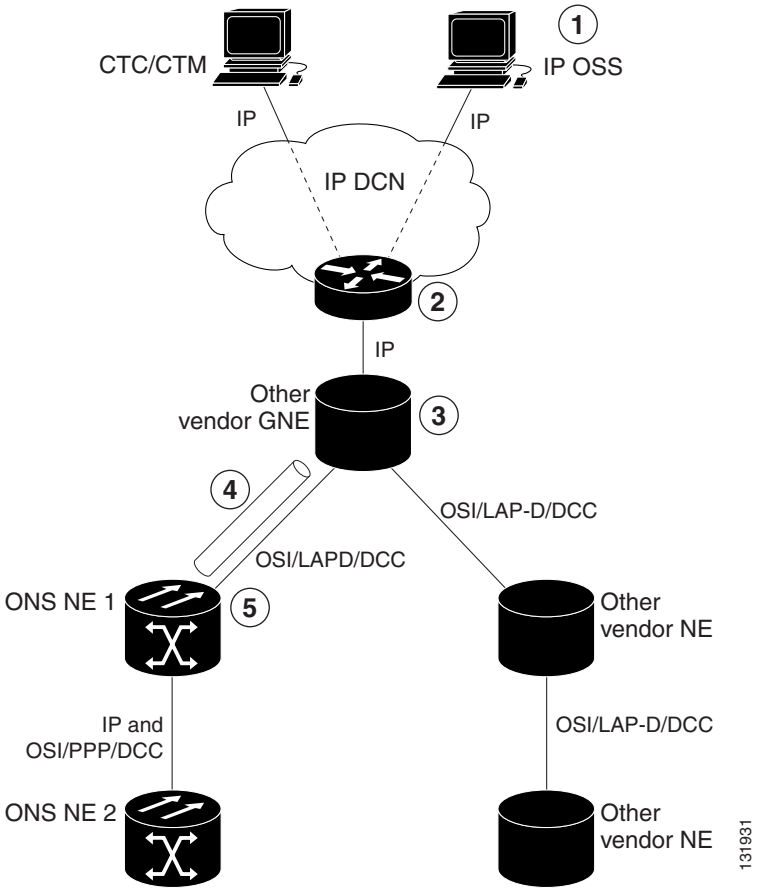
Figure 13-31 OSI/IP Scenario 3: IP OSS, IP DCN, Other Vendor GNE, OSI DCC, and ONS ENE



1	The IP OSS manages the ONS 15454 SDH and other vendor NEs using TL1 and FTP.
2	The other vendor GNE performs mediation for TL1 and FTP, so the DCCs to the ONS 15454 SDH and other vendor NEs are OSI-only.
3	CTC/CTM communicates with ONS 15454 SDH NEs over a IP-over-CLNS tunnel. The tunnel is created from the ONS 15454 SDH node to the external router.
4	The ONS 15454 SDH NE exchanges TL1 over the full OSI stack using FTAM for file transfer.

Figure 13-32 shows the same scenario, except the IP-over-CLNS tunnel endpoint is the GNE rather than the DCN router.

Figure 13-32 OSI/IP Scenario 3 with OSI/IP-over-CLNS Tunnel Endpoint at the GNE

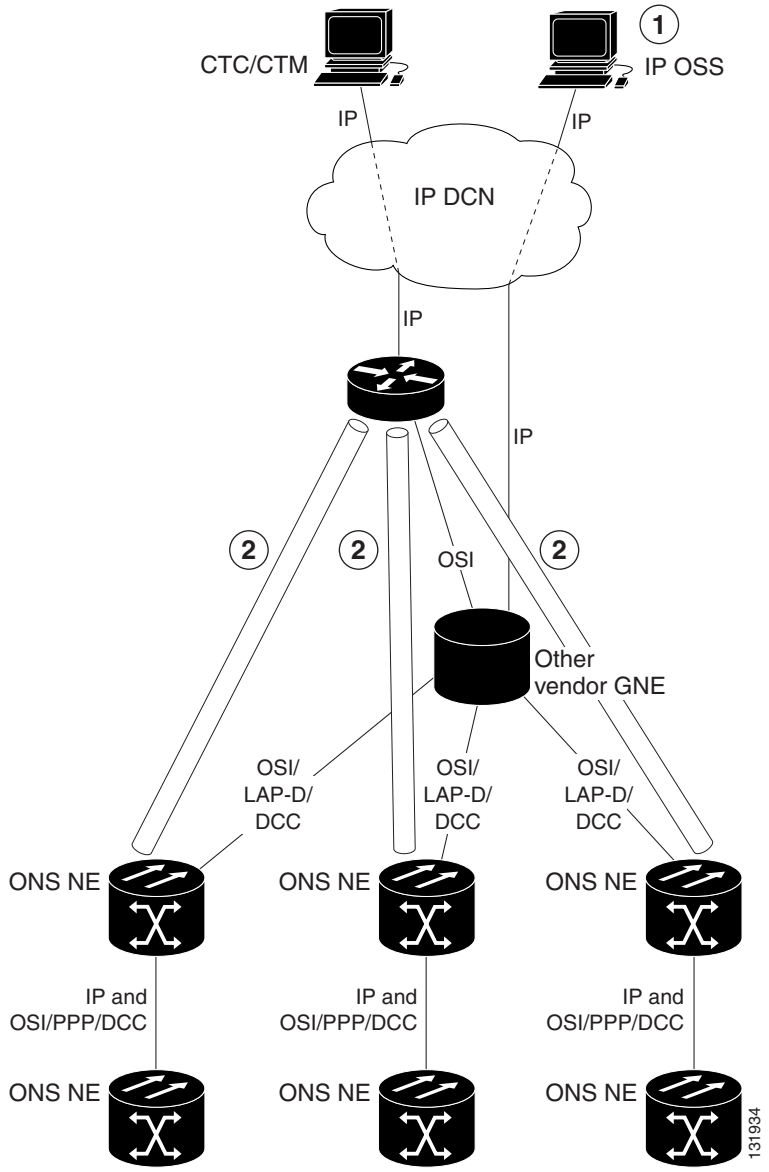


1	The IP OSS manages ONS and other vendor NEs using TL1 and FTP.
2	The other vendor GNE performs mediation for TL1 and FTP, so the DCCs to ONS 15454 SDH and other vendor NEs are OSI-only.
3	CTC/CTM communicates with ONS 15454 SDH NEs over an IP-over-CLNS tunnel between the ONS 15454 SDH and the GNE.
4	ONS 15454 SDH NEs exchange TL1 over the full OSI stack. FTAM is used for file transfer.

13.7.9.4 OSI/IP Scenario 4: Multiple ONS DCC Areas

OSI/IP Scenario 4 (Figure 13-33) is similar to OSI/IP Scenario 3 except that the OSI GNE is subtended by multiple isolated ONS 15454 SDH areas. A separate IP-over-CLNS tunnel is required for each isolated ONS 15454 SDH OSPF area. An alternate approach is to create a single IP-over-CLNS tunnel from CTC/CTM to an ONS 15454 SDH NE, and then to configure a tunnel from that NE to an NE in each isolated OSPF area. This approach requires additional static routes.

Figure 13-33 OSI/IP Scenario 4: Multiple ONS DCC Areas

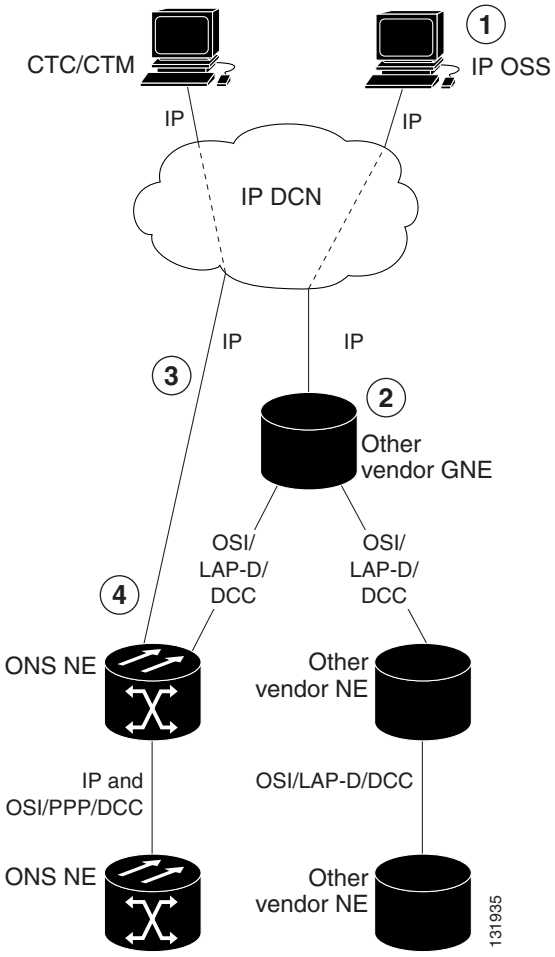


1	The IP OSS manages ONS 15454 SDH and other vendor NEs using TL1 and FTP.
2	A separate tunnel is created for each isolated ONS 15454 SDH DCC area.

13.7.9.5 OSI/IP Scenario 5: GNE Without an OSI DCC Connection

OSI/IP Scenario 5 (Figure 13-34) is similar to OSI/IP Scenario 3 except that the OSI GNE only has an IP connection to the DCN. It does not have an OSI DCN connection to carry CTC/CTM IP traffic through an IP-over-OSI tunnel. A separate DCN to ONS 15454 SDH NE connection is created to provide CTC/CTM access.

Figure 13-34 OSI/IP Scenario 5: GNE Without an OSI DCC Connection

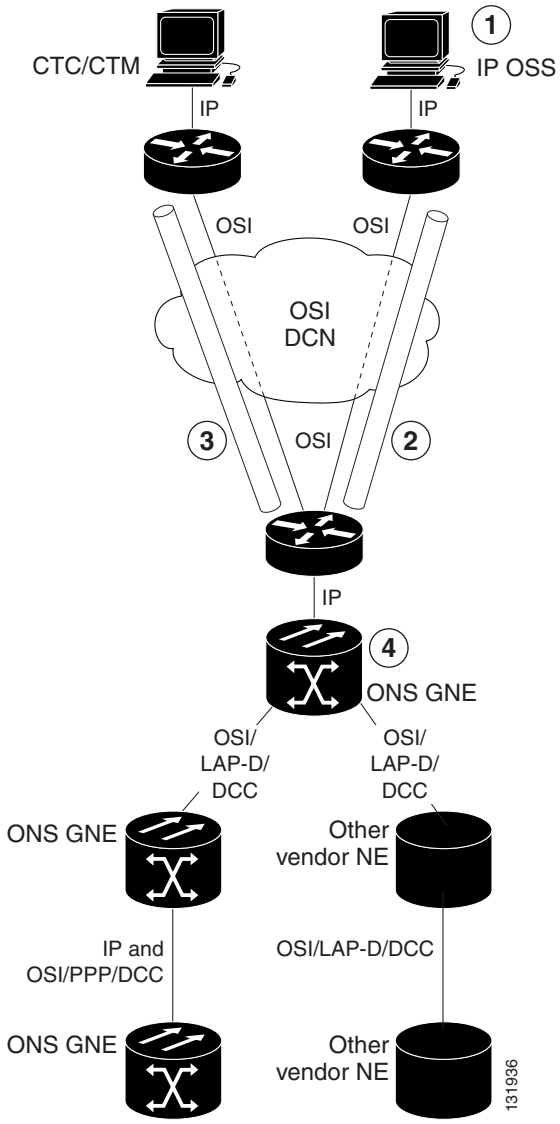


1	The IP OSS manages ONS 15454 SDH and other vendor NEs using TL1 and FTP.
2	The other vendor GNE performs mediation on TL1 and FTP, so DCCs are OSI-only.
3	CTC/CTM communicates with ONS 15454 SDH NEs over a separate IP DCN connection.
4	ONS 15454 SDH NE exchanges TL1 over the full OSI stack. FTAM is used for file transfers.

13.7.9.6 OSI/IP Scenario 6: IP OSS, OSI DCN, ONS GNE, OSI DCC, and Other Vendor ENE

OSI/IP Scenario 6 (Figure 13-35) shows how the ONS 15454 SDH supports OSI DCNs. The OSI DCN has no impact on the ONS 15454 SDH because all IP traffic (CTC/CTM, FTP, and TL1) is tunneled through the OSI DCN.

Figure 13-35 OSI/IP Scenario 6: IP OSS, OSI DCN, ONS GNE, OSI DCC, and Other Vendor ENE

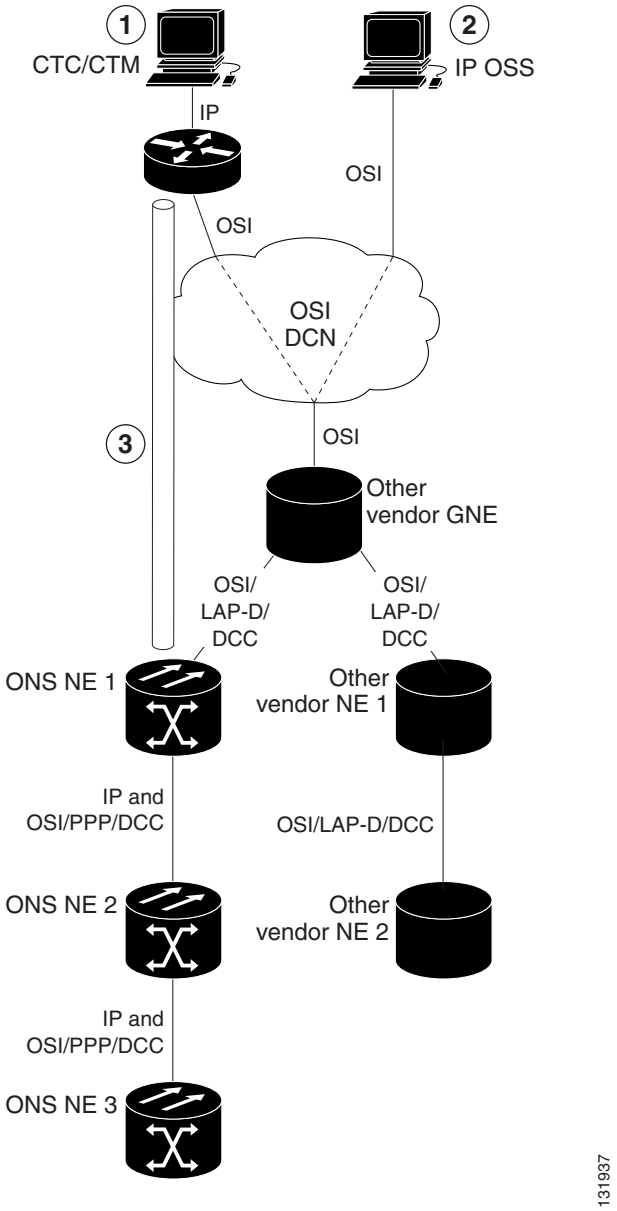


1	The IP OSS manages ONS 15454 SDH and other vendor NEs using TL1 and FTP.
2	OSS IP traffic is tunneled through the DCN to the ONS 15454 SDH GNE.
3	CTC/CTM IP traffic is tunneled through the DCN to the ONS 15454 SDH GNE.
4	The GNE performs mediation for other vendor NEs.

13.7.9.7 OSI/IP Scenario 7: OSI OSS, OSI DCN, Other Vendor GNE, OSI DCC, and ONS NEs

OSI/IP Scenario 7 (Figure 13-36) shows an example of a European network.

Figure 13-36 OSI/IP Scenario 7: OSI OSS, OSI DCN, Other Vender GNE, OSI DCC, and ONS NEs



1	ONS 15454 SDH NEs are managed by CTC/CTM only (TL1/FTP is not used).
2	The OSI OSS manages other vendor NEs only.
3	CTC/CTM communicates with the ONS 15454 SDH over a IP-over-CLNS tunnel between the ONS 15454 SDH NE and external router.

In European networks:

- CTC and CTM are used for management only.
- IP-over-CLNS tunnels are widely accepted and deployed.

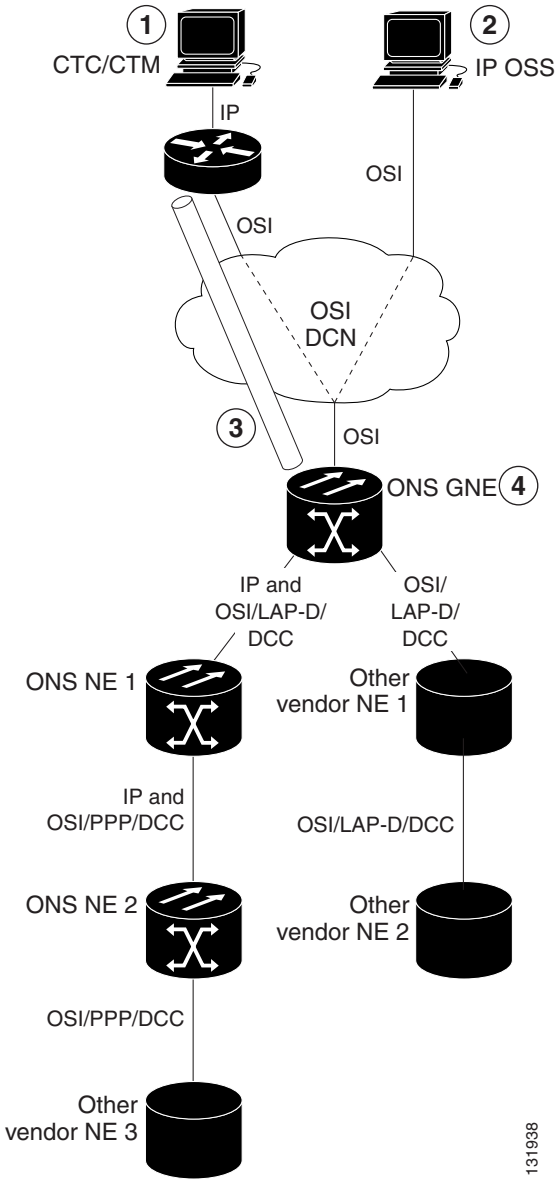
- TL1 management is not required.
- FTP file transfer is not required.
- TL1 and FTAM to FTP mediation is not required.

Management traffic between CTC/CTM and ONS 15454 SDH NEs is carried over an IP-over-CLNS tunnel. A static route is configured on the ONS 15454 SDH that terminates the tunnel (ONS 15454 SDH NE 1) so that downstream ONS 15454 SDH NEs (ONS 15454 SDH NE 2 and 3) know how to reach CTC/CTM.

13.7.9.8 OSI/IP Scenario 8: OSI OSS, OSI DCN, ONS GNE, OSI DCC, and Other Vendor NEs

OSI/IP Scenario 8 (Figure 13-37) is another example of a European network. Similar to OSI/IP Scenario 7, the ONS 15454 SDH NEs are solely managed by CTC/CTM. The CTC/CTM IP traffic is carried over an IP-over-OSI tunnel between an external router and the ONS 15454 SDH GNE. The GNE extracts the IP from the tunnel and forwards it to the destination ONS 15454 SDH. Management traffic between the OSS and other vendor NEs is routed by the ONS 15454 SDH GNE and NEs. Routing is possible because all ONS 15454 SDH NEs run dual stacks (OSI and IP).

Figure 13-37 OSI/IP Scenario 8: OSI OSS, OSI DCN, ONS GNE, OSI DCC, and Other Vender NEs



1	The ONS NEs are managed by CTC/CTM only (TL1/FTP is not used).
2	The OSI OSS manages other vendor NEs only.
3	CTC/CTM communicates with the ONS 15454 SDH over an IP-over-CLNS tunnel between the ONS 15454 SDH NE and the external router. A static route is needed on the GNE.
4	The ONS 15454 SDH GNE routes OSI traffic to other vendor NEs. No IP-over-CLNS tunnel is needed.

13.7.10 Provisioning OSI in CTC

Table 13-18 shows the OSI actions that are performed from the node view Provisioning tab. Refer to the *Cisco ONS 15454 SDH Procedure Guide* for OSI procedures and tasks.

Table 13-18 OSI Actions from the CTC Provisioning Tab

Tab	Actions
OSI > Main Setup	• View and edit Primary Area Address. • Change OSI routing mode. • Change LSP buffers.
OSI > TARP > Config	Configure the TARP parameters: • PDU L1/L2 propagation and origination. • TARP data cache and loop detection buffer. • LAN storm suppression. • Type 4 PDU on startup. • TARP timers: LDB, T1, T2, T3, T4.
OSI > TARP > Static TDC	Add and delete static TARP data cache entries.
OSI > TARP > MAT	Add and delete static manual area table entries.
OSI > Routers > Setup	• Enable and disable routers. • Add, delete, and edit manual area addresses.
OSI > Routers > Subnets	Edit RS-DCC, MS-DCC, and LAN subnets that are provisioned for OSI.
OSI > Tunnels	Add, delete, and edit Cisco and IP-over-CLNS tunnels.
Comm Channels > RS-DCC	• Add OSI configuration to an RS-DCC. • Choose the data link layer protocol, PPP or LAP-D.
Comm Channels > MS-DCC	• Add OSI configuration to an RS-DCC.

Table 13-18 shows the OSI actions that are performed from the node view Maintenance tab.

Table 13-19 OSI Actions from the CTC Maintenance Tab

Tab	Actions
OSI > ISIS RIB	View the IS-IS routing table.
OSI > ESIS RIB	View ESs that are attached to ISs.
OSI > TDC	• View the TARP data cache and identify static and dynamic entries. • Perform TID to NSAP resolutions. • Flush the TDC.

Alarm Monitoring and Management

This chapter explains how to manage alarms with Cisco Transport Controller (CTC). To troubleshoot specific alarms, refer to the *Cisco ONS 15454 SDH Troubleshooting Guide*. Chapter topics include:

- 14.1 Overview, page 14-1
- 14.2 LCD Alarm Counts, page 14-1
- 14.3 Alarm Information, page 14-2
- 14.4 Alarm Severities, page 14-10
- 14.5 Alarm Profiles, page 14-10
- 14.6 Alarm Suppression, page 14-14
- 14.7 External Alarms and Controls, page 14-15

14.1 Overview

CTC detects and reports SDH alarms generated by the Cisco ONS 15454 SDH and the larger SDH network. You can use CTC to monitor and manage alarms at the card, node, or network level. Default alarm severities conform to the ITU-T G.733 standard, but you can set alarm severities in customized alarm profiles or suppress CTC alarm reporting. For a detailed description of the standard ITU-T categories employed by Optical Networking System (ONS) nodes, refer to the *Cisco ONS 15454 SDH Troubleshooting Guide.*

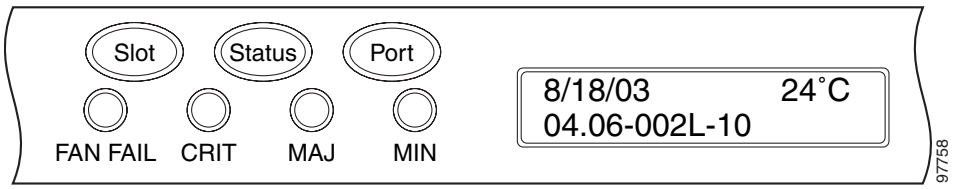
Note ONS 15454 SDH alarms can also be monitored and managed through a network management system (NMS).

14.2 LCD Alarm Counts

You can view node, slot, or port-level alarm counts and summaries using the buttons on the ONS 15454 SDH LCD panel. The Slot and Port buttons toggle between display types; the Slot button toggles between node display and slot display, and the Port button toggles between slot and port views. Pressing the Status button after you choose the display mode changes the display from alarm count to alarm summary.

The ONS 15454 SDH has a one-button update for some commonly viewed alarm counts. If you press the Slot button once and then wait eight seconds, the display automatically changes from a slot alarm count to a slot alarm summary. If you press the Port button to toggle to port-level display, you can use the Port button to toggle to a specific slot and to view each port's port-level alarm count. Figure 14-1 shows the LCD panel layout.

Figure 14-1 Shelf LCD Panel



14.3 Alarm Information

In the card, node, or network CTC view, click the Alarms tab to display the alarms for that card, node, or network. The Alarms window shows alarms in conformance with ITU-T G.733. This means that if a network problem causes two alarms, such as loss of frame (LOF) and loss of signal (LOS), CTC only shows the LOS alarm in this window because it supersedes LOF. (The LOF alarm can still be retrieved in the Conditions window.)

The Path Width column in the Alarms and Conditions tabs expands upon alarmed object information contained in the access identifier string (such as "VC4-6-1-6") by giving the number of VC-4s contained in the alarmed path. For example, the Path Width will tell you whether a Critical alarm applies to a VC-4 (where the column will show 1) or a VC-12 (where the column will show 3). If the path contains a smaller circuit size than VC-4, the column is empty.

Table 14-1 lists the column headings and the information recorded in each column.

Table 14-1 Alarms Column Descriptions

Column	Information Recorded
New	Indicates a new alarm. To change this status, click either the **Synchronize** button or the **Delete Cleared Alarms** button.
Date	Date and time of the alarm.
Node	Shows the name of the node where the condition or alarm occurred. (Visible in network view.).
Object	The object for an HPmon or LPmon alarm or condition.
Eqpt Type	Card type in this slot.
Shelf	For dense wavelength division multiplexing (DWDM) configurations, the shelf where the alarmed object is located. Visible in network view.
Slot	Slot where the alarm occurred (appears only in network and node view).
Port	Port where the alarm is raised. For HPTerm and LPTerm, the port refers to the upstream card it is partnered with.

Table 14-1 Alarms Column Descriptions (continued)

Column	Information Recorded
Path Width	Indicates how many VC-4s are contained in an alarmed path. (For any non-VC-4 object, such as a VC-3, the column is blank.) This information complements the alarm object notation, which is explained in Table 14-3.
Sev	Severity level: CR (Critical), MJ (Major), MN (Minor), NA (Not Alarmed), NR (Not Reported).
ST	Status: R (raised), C (clear), T (transient).
SA	When checked, indicates a service-affecting alarm.
Cond	The error message/alarm name. These names are alphabetically defined in the "Alarm Troubleshooting" chapter of the *Cisco ONS 15454 SDH Troubleshooting Guide.*
Description	Description of the alarm.
Num	Num (number) is the quantity of alarm messages received, and is incremented automatically as alarms occur to display the current total of received error messages.(The column is hidden by default; to view it, right-click a column and choose **Show Column > Num**.)
Ref	Ref (reference) is a unique identification number assigned to each alarm to reference a specific alarm message that is displayed. (The column is hidden by default; to view it, right-click a column and choose **Show Column > Ref**.)

Note When an entity is put in the Locked,maintenance administrative state, the ONS 15454 SDH suppresses all standing alarms on that entity. All alarms and events appear on the Conditions tab. You can change this behavior for the LPBKFACILITY and LPBKTERMINAL alarms. To display these alarms on the Alarms tab, set the NODE.general.ReportLoopbackConditionsOnPortsInLocked,Maintenance to TRUE on the NE Defaults tab.

Table 14-2 lists the color codes for alarm and condition severities. The inherited (I) and unset (U) severities are only listed in the network view Provisioning > Alarm Profiles tab.

Table 14-2 Color Codes for Alarm and Condition Severities

Color	Description
Red	Raised Critical (CR) alarm
Orange	Raised Major (MJ) alarm
Yellow	Raised Minor (MN) alarm
Magenta (pink)	Raised Not Alarmed (NA) condition
Blue	Raised Not Reported (NR) condition
White	Cleared (C) alarm or condition

Note Major and Minor alarms may appear yellow in CTC under certain circumstances. This is not due to a CTC problem but to a workstation memory and color utilization problem. For example, a workstation might run out of colors if many color-intensive applications are running. When using Netscape, you can limit the number of colors used by launching it from the command line with either the -install option or the -ncols 32 option.

In network view, CTC identifies STM and VC alarm objects based upon the object IDs. Table 14-3 lists the object numbering schemes for the MON (such as HPMon and LPMon) and TERM (such as HPTerm and LPTerm) objects.

Table 14-3 Release 4.0 and Later Port-Based Alarm Numbering Scheme

STM and VC Alarm Numbering		
MON object	VC4-<slot>-<port>-<VC_within_port> For example, VC4-6-1-6	Port=1
TERM object	VC4-<slot>-<VC_within_slot> For example, VC4-6-6	Port=1

14.3.1 Viewing Alarms With Each Node's Time Zone

By default, alarms and conditions are displayed with the time stamp of the CTC workstation where you are viewing them. But you can set the node to report alarms (and conditions) using the time zone where the node is located by clicking Edit > Preferences, and clicking the Display Events Using Each Node's Time Zone check box.

14.3.2 Controlling Alarm Display

You can control the display of the alarms shown on the Alarms window. Table 14-4 shows the actions you can perform in the Alarms window.

Table 14-4 Alarm Display

Button/Check Box/Tool	Action
Filter button	Allows you to change the display on the Alarms window to show only alarms that meet a certain severity level, occur in a specified time frame, and/or reflect specific conditions. For example, you can set the filter so that only Critical alarms display on the window. If you enable the Filter feature by clicking the Filter button in one CTC view, such as node view, it is enabled in the other views as well (card view and network view).
Synchronize button	Updates the alarm display. Although CTC displays alarms in real time, the Synchronize button allows you to verify the alarm display. This is particularly useful during provisioning or troubleshooting.
Delete Cleared Alarms button	Deletes, from the view, alarms that have been cleared.

Table 14-4 Alarm Display (continued)

Button/Check Box/Tool	Action
AutoDelete Cleared Alarms check box	If checked, CTC automatically deletes cleared alarms.
Filter tool	Enables or disables alarm filtering in the card, node, or network view. When enabled or disabled, this state applies to other views for that node and for all other nodes in the network. For example, if the Filter tool is enabled in the node (default login) view Alarms window, the network view Alarms window and card view Alarms window also have the tool enabled. All other nodes in the network also have the tool enabled.

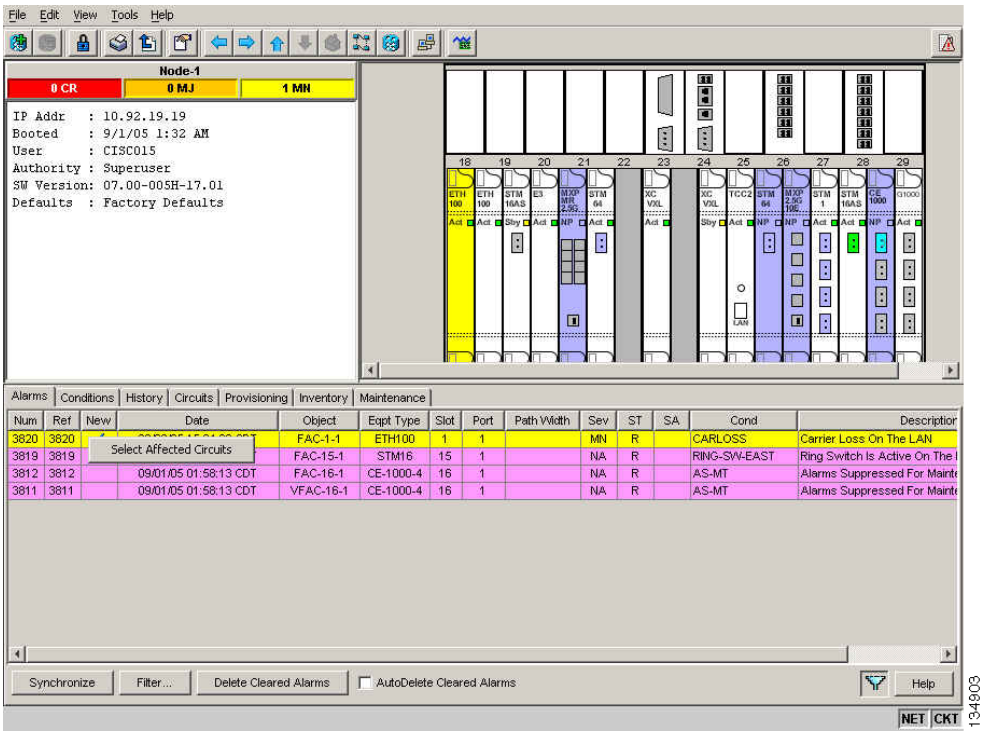
14.3.3 Filtering Alarms

The alarm display can be filtered to prevent display of alarms with certain severities or alarms that occurred between certain dates and times. You can set the filtering parameters by clicking the Filter button at the bottom-left of the Alarms window. You can turn the filter on or off by clicking the Filter tool at the bottom-right of the window. CTC retains your filter activation setting. For example, if you turn the filter on and then log out, CTC keeps the filter active the next time you log in.

14.3.4 Viewing Alarm-Affected Circuits

A user can view which ONS 15454 SDH circuits are affected by a specific alarm by positioning the cursor over the alarm in the Alarm window and right-clicking. A shortcut menu appears (Figure 14-2).

Figure 14-2 Select Affected Circuits Option


File Edit View Tools Help
Node-1
0 CR
0 MJ
1 MN
IP Addr : 10.92.19.19
Booted : 9/1/05 1:32 AM
User : CISCO15
Authority : Superuser
SW Version: 07.00-005H-17.01
Defaults : Factory Defaults
Alarms Conditions History Circuits Provisioning Inventory Maintenance
Num Ref New Date Object Eqpt Type Slot Port Path Width Sev ST SA Cond Description
3820 3820 FAC-1-1 ETH100 1 1 MN R CARLOSS Carrier Loss On The LAN
3819 3819 FAC-15-1 STM16 15 1 NA R RING-SW-EAST Ring Switch Is Active On The
3812 3812 09/01/05 01:58:13 CDT FAC-16-1 CE-1000-4 16 1 NA R AS-MT Alarms Suppressed For Maint
3811 3811 09/01/05 01:58:13 CDT VFAC-16-1 CE-1000-4 16 1 NA R AS-MT Alarms Suppressed For Maint
Select Affected Circuits
Synchronize
Filter...
Delete Cleared Alarms
AutoDelete Cleared Alarms
Help
NET CKT
134903

When the user selects the Select Affected Circuits option, the Circuits window opens to show the circuits that are affected by the alarm.

14.3.5 Conditions Tab

The Conditions window displays retrieved fault conditions. A condition is a fault or status detected by ONS 15454 SDH hardware or software. When a condition occurs and continues for a minimum period, CTC raises a condition, which is a flag showing that this particular condition currently exists on the ONS 15454 SDH.

The Conditions window shows all conditions that occur, including those that are superseded. For instance, if a network problem causes two alarms, such as LOF and LOS, CTC shows both the LOF and LOS conditions in this window (even though LOS supersedes LOF). Having all conditions visible can be helpful when troubleshooting the ONS 15454 SDH. If you want to retrieve conditions that obey a root-cause hierarchy (that is, LOS supersedes and replaces LOF), you can exclude the same root causes by checking “Exclude Same Root Cause” check box in the window.

Fault conditions include reported alarms and Not Reported or Not Alarmed conditions. Refer to the trouble notifications information in the *Cisco ONS 15454 SDH Troubleshooting Guide* for more information about alarm and condition classifications.

14.3.6 Controlling the Conditions Display

You can control the display of the conditions on the Conditions window. Table 14-5 shows the actions you can perform in the window.

Table 14-5 Conditions Display

Button	Action
Retrieve	Retrieves the current set of all existing fault conditions, as maintained by the alarm manager, from the ONS 15454 SDH.
Filter	Allows you to change the Conditions window display to only show the conditions that meet a certain severity level or occur in a specified time. For example, you can set the filter so that only Critical conditions display on the window. **Note** There is a Filter button on the lower-right of the window that allows you to enable or disable the filter feature.
Exclude Same Root Cause	Retrieves conditions that obey a root-cause hierarchy (for example, LOS supersedes and replaces LOF).

14.3.6.1 Retrieving and Displaying Conditions

The current set of all existing conditions maintained by the alarm manager can be seen when you click the Retrieve button. The set of conditions retrieved is relative to the view. For example, if you click the button while displaying the node view, node-specific conditions are displayed. If you click the button while displaying the network view, all conditions for the network (including ONS 15454 SDH nodes and other connected nodes) are displayed, and the card view shows only card-specific conditions.

You can also set a node to display conditions using the time zone where the node is located, rather than the time zone of the PC where they are being viewed. See the "14.3.1 Viewing Alarms With Each Node's Time Zone" section on page 14-4 for more information.

14.3.6.2 Conditions Column Descriptions

Table 14-6 lists the Conditions window column headings and the information recorded in each column.

Table 14-6 Conditions Column Description

Column	Information Recorded
New	Indicates a new condition.
Date	Date and time of the condition.
Node	Shows the name of the node where the condition or alarm occurred. (Visible in network view.)
Object	The object for an HPmon or LPmon.
Eqpt Type	Card type in this slot.
Shelf	For DWDM configurations, the shelf where the alarmed object is located. Visible in network view.
Slot	Slot where the condition occurred (appears only in network and node view).
Port	Port where the alarm is raised. For HPTerm and LPTerm, the port refers to the upstream card it is partnered with.
Path Width	Indicates how many VC-4s are contained in an alarmed path. (For any non-VC-4 object, such as a VC-3, the column is blank.) This information complements the alarm object notation, which is explained in Table 14-3.

Table 14-6 Conditions Column Description (continued)

Column	Information Recorded
Sev[1]	Severity level: CR (Critical), MJ (Major), MN (Minor), NA (Not Alarmed), NR (Not Reported).
SA[1]	Indicates a service-affecting alarm (when checked).
Cond	The error message/alarm name; these names are alphabetically defined in the "Alarm Troubleshooting" chapter of the *Cisco ONS 15454 SDH Troubleshooting Guide.*
Description	Description of the condition.

1. All alarms, their severities, and service-affecting statuses are also displayed in the Condition tab unless you choose to filter the alarm from the display using the Filter button.

14.3.6.3 Filtering Conditions

The condition display can be filtered to prevent display of conditions (including alarms) with certain severities or that occurred between certain dates. You can set the filtering parameters by clicking the Filter button at the bottom-left of the Conditions window. You can turn the filter on or off by clicking the Filter tool at the bottom-right of the window. CTC retains your filter activation setting. For example, if you turn the filter on and then log out, CTC keeps the filter active the next time you log in.

14.3.7 Viewing History

The History window displays historic alarm or condition data for the node or for your login session. You can chose to display only alarm history, only events, or both by checking check boxes in the History > Shelf window. You can view network-level alarm and condition history, such as for circuits, for all the nodes visible in network view. At the node level, you can see all port (facility), card, STS, and system-level history entries for that node. For example, protection-switching events or performance-monitoring threshold crossings appear here. If you double-click a card, you can view all port, card, and STS alarm or condition history that directly affects the card.

Note In the Preference dialog General tab, the Maximum History Entries value only applies to the Session window.

Different views of CTC display the following kinds of history:

- The History > Session window is shown in network view, node view, and card view. It shows alarms and conditions that occurred during the current user CTC session.
- The History > Shelf window is only shown in node view. It shows the alarms and conditions that occurred on the node since CTC software was operated on the node.
- The History > Card window is only shown in card view. It shows the alarms and conditions that occurred on the card since CTC software was installed on the node.

Tip Double-click an alarm in the History window to display the corresponding view. For example, double-clicking a card alarm takes you to card view. In network view, double-clicking a node alarm takes you to node view.

If you check the History window Alarms check box, you display the node history of alarms. If you check the Events check box, you display the node history of Not Alarmed and transient events (conditions). If you check both check boxes, you retrieve node history for both.

14.3.7.1 History Column Descriptions

Table 14-7 lists the History window column headings and the information recorded in each column.

Table 14-7 History Column Description

Column	Information Recorded
Date	Date and time of the condition.
Node	Shows the name of the node where the condition or alarm occurred. (Visible in network view.)
Object	Identifier for the condition object. For an LPMon or HPMon, the object.
Eqpt Type	Card type in this slot (only displays in network view and node view).
Shelf	For DWDM configurations, the shelf where the alarmed object is located. Visible in network view.
Slot	Slot where the condition occurred (only displays in network view and node view).
Port	Port where the alarm is raised. For HPTerm and LPTerm, the port refers to the upstream card it is partnered with.
Path Width	Indicates how many VC-4s are contained in an alarmed path. (For any non-VC-4 object, such as a VC-3, the column is blank.) This information complements the alarm object notation, which is explained in Table 14-3.
Sev	Severity level: Critical (CR), Major (MJ), Minor (MN), Not Alarmed (NA), Not Reported (NR).
ST	Status: raised (R), cleared (C), or transient (T).
SA	Indicates a service-affecting alarm (when checked).
Cond	Condition name.
Description	Description of the condition.
Num	An incrementing count of alarm or condition messages. (The column is hidden by default; to view it, right-click a column and choose **Show Column > Num**.)
Ref	The reference number assigned to the alarm or condition. (The column is hidden by default; to view it, right-click a column and choose **Show Column > Ref**.)

14.3.7.2 Retrieving and Displaying Alarm and Condition History

You can retrieve and view the history of alarms and conditions, as well as transients (passing notifications of processes as they occur) in the CTC history window. The information in this window is specific to the view where it is shown (that is, network history in the network view, node history in the node view, and card history in the card view).

The node and card history views are each divided into two tabs. In node view, when you click the Retrieve button, you can see the history of alarms, conditions, and transients that have occurred on the node in the History > Shelf window, and the history of alarms, conditions, and transients that have occurred on the node during your login session in the History > Session window. In the card-view history window, after you retrieve the card history, you can see the history of alarms, conditions, and transients

on the card in the History > Card window, or a history of alarms, conditions, and transients that have occurred during your login session in the History > Session window. You can also filter the severities and occurrence period in these history windows.

14.3.8 Alarm History and Log Buffer Capacities

The ONS 15454 SDH alarm history log, stored in the TCC2/TCC2P RSA memory, contains four categories of alarms. These include:

- CR severity alarms
- MJ severity alarms
- MN severity alarms
- the combined group of cleared, Not Alarmed severity, and Not Reported severity alarms

Each category can store between 4 and 640 alarm chunks, or entries. In each category, when the upper limit is reached, the oldest entry in the category is deleted. The capacity is not user-provisionable.

CTC also has a log buffer, separate from the alarm history log, that pertains to the total number of entries displayed in the Alarms, Conditions, and History windows. The total capacity is provisionable up to 5,000 entries. When the upper limit is reached, the oldest entries are deleted.

14.4 Alarm Severities

ONS 15454 SDH alarm severities follow the ITU-T G.733 standard, so a condition might be Alarmed (at a severity of Critical [CR], Major [MJ], or Minor [MN]), Not Alarmed (NA) or Not Reported (NR). These severities are reported in the CTC software Alarms, Conditions, and History windows at all levels: network, shelf, and card.

ONS equipment provides a standard profile named Default listing all alarms and conditions with severity settings based on ITU-T G.733 and other standards, but users can create their own profiles with different settings for some or all conditions and apply these wherever desired. (See the "14.5 Alarm Profiles" section on page 14-10.) For example, in a custom alarm profile, the default severity of a carrier loss (CARLOSS) alarm on an Ethernet port could be changed from Major to Critical. The profile allows setting to Not Reported or Not Alarmed, as well as the three alarmed severities.

Critical and Major severities are only used for service-affecting alarms. If a condition is set as Critical or Major by profile, it will raise as a Minor alarm in the following situations:

- In a protection group, if the alarm is on a standby entity (side not carrying traffic)
- If the alarmed entity has no traffic provisioned on it, so no service is lost

Because of this possibility of being raised at two different levels, the alarm profile pane shows Critical as CR / MN and Major as MJ / MN.

14.5 Alarm Profiles

The alarm profiles feature allows you to change default alarm severities by creating unique alarm profiles for individual ONS 15454 SDH ports, cards, or nodes. A created alarm profile can be applied to any node on the network. Alarm profiles can be saved to a file and imported elsewhere in the network, but the profile must be stored locally on a node before it can be applied to the node, its cards, or its cards' ports.

CTC can store up to ten active alarm profiles at any time to apply to the node. Custom profiles can take eight of these active profile positions. Two other profiles, Default profile and Inherited profile, are reserved by the NE, and cannot be edited.The reserved Default profile contains ITU-T G.733 severities. The reserved Inherited profile allows port alarm severities to be governed by the card-level severities, or card alarm severities to be determined by the node-level severities.

If one or more alarm profiles have been stored as files from elsewhere in the network onto the local PC or server hard drive where CTC resides, you can utilize as many profiles as you can physically store by deleting and replacing them locally in CTC so that only eight are active at any given time.

14.5.1 Creating and Modifying Alarm Profiles

Alarm profiles are created in the network view using the Provisioning > Alarm Profiles tabs. A default alarm profile following ITU-T G.733 is preprovisioned for every alarm. After loading the default profile or another profile on the node, you can use the Clone feature to create custom profiles. After the new profile is created, the Alarm Profiles window shows the original profile—frequently Default—and the new profile. The Default alarm profile list contains alarm and condition severities that correspond when applicable to default values established in ITU-T G.733. Up to ten profiles, including the two reserved profiles (Inherited and Default) can be stored in CTC.

Note The alarm profile list contains a master list of alarms that is used for a mixed node network. Some of these alarms might not be used in all ONS nodes.

Note All default or user-defined severity settings that are Critical (CR) or Major (MJ) are demoted to Minor (MN) in non-service-affecting situations.

Tip To see the full list of profiles including those available for loading or cloning, click the Available button. You must load a profile before you can clone it.

Wherever it is applied, the Default alarm profile sets severities to standard ITU-T G.733 settings. The Inherited profile sets alarm severity to inherited (I) so that alarms inherit, or copy, severities from the next-highest level. For example, a card with an Inherited alarm profile copies the severities used by the node housing the card. If you choose the Inherited profile from the network view, the severities at the lower levels (node and card) be copied from this selection.

You do not have to apply a single severity profile to the node-, card-, and port-level alarms. Different profiles can be applied at different levels. You could use the inherited or default profile on a node and on all cards and ports, but apply a custom profile that downgrades an alarm on one particular card. For example, you might choose to downgrade an STM-N unequipped path alarm (HP-UNEQ) from Critical (CR) to Not Alarmed (NA) on an optical card because this alarm raises and then clears every time you create a circuit. HP-UNEQ alarms for the card with the custom profile would not display on the Alarms tab. (But they would still be recorded in the Conditions and History tabs.)

When you modify severities in an alarm profile, the following rules apply:

- All Critical (CR) or Major (MJ) default or user-defined severity settings are demoted to Minor (MN) in Non-Service-Affecting (NSA) situations.
- Default severities are used for all alarms and conditions until you create a new profile and apply it.

14.5.2 Alarm Profile Buttons

The Alarm Profiles window displays six buttons at the bottom. Table 14-8 lists and describes each of the alarm profile buttons and their functions.

Table 14-8 Alarm Profile Buttons

Button	Description
New	Adds a new alarm profile.
Load	Loads a profile to a node or a file.
Store	Saves profiles on a node (or nodes) or in a file.
Delete	Deletes profiles from a node.
Compare	Displays differences between alarm profiles (for example, individual alarms that are not configured equivalently between profiles).
Available	Displays all profiles available on each node.
Usage	Displays all entities (nodes and alarm subjects) present in the network and which profiles contain the alarm. Can be printed.

14.5.3 Alarm Profile Editing

Table 14-9 lists and describes the five profile-editing options available when you right-click an alarm item in the profile column.

Table 14-9 Alarm Profile Editing Options

Button	Description
Store	Saves a profile in a node or in a file.
Rename	Changes a profile name.
Clone	Creates a profile that contains the same alarm severity settings as the profile being cloned.
Reset	Restores a profile to its previous state or to the original state (if it has not yet been applied).
Remove	Removes a profile from the table editor.

14.5.4 Alarm Severity Options

To change or assign alarm severity, left-click the alarm severity you want to change in the alarm profile column. Seven severity levels appear for the alarm:

- Not Reported (NR)
- Not Alarmed (NA)
- Minor (MN)
- Major (MJ)
- Critical (CR)

- Use Default
- Transient (T)

Transient and Use Default severity alarms only appear in alarm profiles. They do not appear when you view alarms, history, or conditions.

14.5.5 Row Display Options

In the network view, the Alarm Profiles window displays the following check boxes at the bottom of the window:

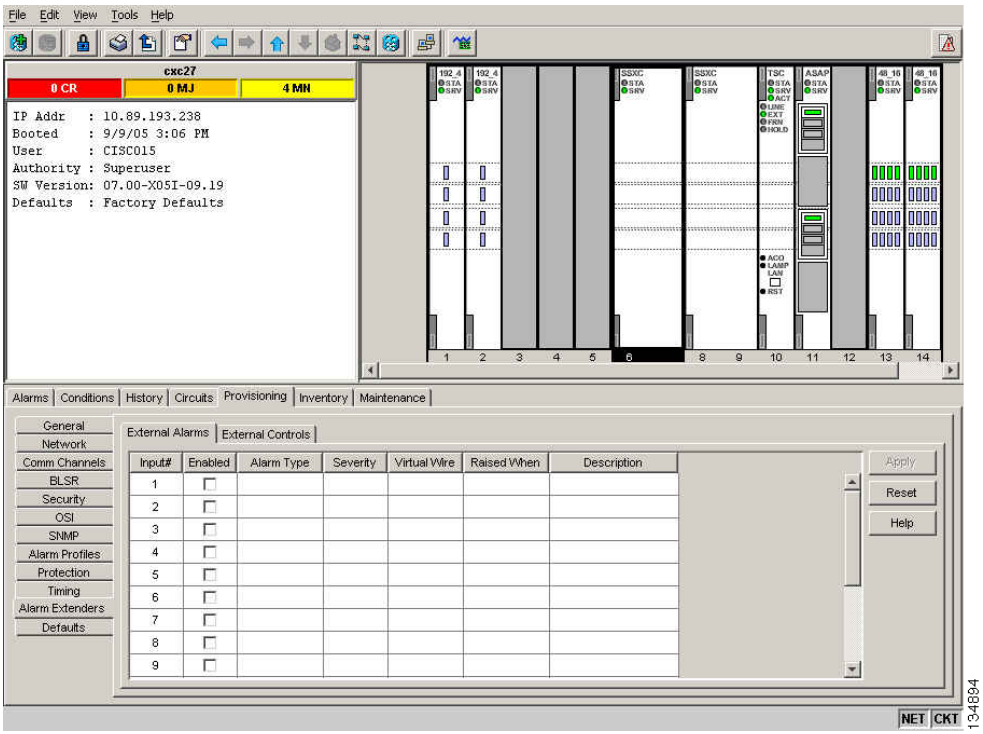
- Only show service-affecting severities—If unchecked, the editor shows severities in the format <sev1>/<sev2> where <sev1> is a service-affecting severity and <sev2> is not service-affecting. If checked, the editor only shows <sev1> alarms.
- Hide reference values—Highlights alarms with non-default severities by clearing alarm cells with default severities. This check-box is normally greyed out. It becomes active only when more than one profile is listed in the Alarm Profile Editor window. (The check box text changes to “Hide Values matching profile Default” in this case.
- Hide identical rows—Hides rows of alarms that contain the same severity for each profile.

14.5.6 Applying Alarm Profiles

In CTC node view, the Alarm Behavior window displays alarm profiles for the node. In card view, the Alarm Behavior window displays the alarm profiles for the selected card. Alarm profiles form a hierarchy. A node-level alarm profile applies to all cards in the node except cards that have their own profiles. A card-level alarm profile applies to all ports on the card except ports that have their own profiles.

At the node level, you can apply profile changes on a card-by-card basis or set a profile for the entire node. At the card-level view, you can apply profile changes on a port-by-port basis or set alarm profiles for all ports on that card. Figure 14-3 shows the alarm profiles for an eight-port STM-1 card.

Figure 14-3 Alarm Profile for an STM-1 Card



14.6 Alarm Suppression

The following sections explain alarm suppression features for the ONS 15454 SDH.

14.6.1 Alarms Suppressed for Maintenance

When you place a port in Locked,maintenance administrative state, this raises the alarm suppressed for maintenance (AS-MT) alarm in the Conditions and History windows[1] and causes subsequently raised alarms for that port to be suppressed.

While the facility is in the Locked,maintenance state, any alarms or conditions that are raised and suppressed on it (for example, a transmit failure [TRMT] alarm) are reported in the Conditions window and show their normal severity in the Sev column. The suppressed alarms are not shown in the Alarms and History windows. (These windows only show AS-MT). When you place the port back into Unlocked,automaticInService administrative state, the AS-MT alarm is resolved in all three windows. Suppressed alarms remain raised in the Conditions window until they are cleared.

1. AS-MT can be seen in the Alarms window as well if you have set the Filter dialog box to show NA severity events.

14.6.2 Alarms Suppressed by User Command

In the Provisioning > Alarm Profiles > Alarm Behavior tabs, the ONS 15454 SDH has an alarm suppression option that clears raised alarm messages for the node, chassis, one or more slots (cards), or one or more ports. Using this option raises the alarms suppressed by user command, or AS-CMD alarm. The AS-CMD alarm, like the AS-MT alarm, appears in the Conditions, and History[1] windows. Suppressed conditions (including alarms) appear only in the Conditions window--showing their normal severity in the Sev column. When the Suppress Alarms check box is unchecked, the AS-CMD alarm is cleared from all three windows.

A suppression command applied at a higher level does not supersede a command applied at a lower level. For example, applying a node-level alarm suppression command makes all raised alarms for the node appear to be cleared, but it does not cancel out card-level or port-level suppression. Each of these conditions can exist independently and must be cleared independently.

Caution Use alarm suppression with caution. If multiple CTC or TL1 sessions are open, suppressing the alarms in one session suppresses the alarms in all other open sessions.

14.7 External Alarms and Controls

External alarm inputs can be provisioned on the Alarm Interface Controller-International (AIC-I) card for external sensors such as an open door and flood sensors, temperature sensors, and other environmental conditions. External control outputs on this card allow you to drive external visual or audible devices such as bells and lights. They can control other devices such as generators, heaters, and fans.

You provision external alarms in the AIC-I card view Provisioning > Card > External Alarms tab. Provision controls in the AIC-I card view Provisioning > Card > External Controls tab. Up to 16 external alarm inputs and 4 external controls are available with the AIC-I card.

14.7.1 External Alarm Input

You can provision each alarm input separately. Provisionable characteristics of external alarm inputs include:

- Alarm type, from a list of possibilities in a drop-down list
- Alarm severity (CR, MJ, MN, NA, and NR)
- Alarm-trigger setting (open or closed): Open means that the normal condition is no current flowing through the contact, and the alarm is generated when current does flow; closed means that normal condition is to have current flowing through the contact, and the alarm is generated with current stops flowing.
- Virtual wire associated with the alarm
- CTC alarm log description (up to 63 characters)

Note If you provision an external alarm to raise when a contact is open, and you have not attached the alarm cable, the alarm will remain raised until the alarm cable is connected.

Note When you provision an external alarm, the alarm object is ENV-IN-*nn*. The variable *nn* refers to the external alarm's number, regardless of the name you assign.

14.7.2 External Control Output

You can provision each alarm output separately. Provisionable characteristics of alarm outputs include:

- Control type
- Trigger type (alarm or virtual wire)
- Description for CTC display
- Closure setting (manually or by trigger). If you provision the output closure to be triggered, the following characteristics can be used as triggers:
  - Local NE alarm severity—A chosen alarm severity (for example, Major) and any higher-severity alarm (in this case, Critical) causes output closure.
  - Remote NE alarm severity—Similar to local NE alarm severity trigger setting, but applies to remote alarms.
  - Virtual wire entities—You can provision an alarm that is input to a virtual wire to trigger an external control output.

CHAPTER 15

Performance Monitoring

Performance monitoring (PM) parameters are used by service providers to gather, store, set thresholds, and report performance data for early detection of problems. In this chapter, PM parameters and concepts are defined for electrical cards, Ethernet cards, and optical cards in the Cisco ONS 15454 SDH.

For information about enabling and viewing PM values, refer to the *Cisco ONS 15454 SDH Procedure Guide*.

Chapter topics include:

- 15.1 Threshold Performance Monitoring, page 15-1
- 15.2 Intermediate-Path Performance Monitoring, page 15-3
- 15.3 Pointer Justification Count Performance Monitoring, page 15-4
- 15.4 Performance Monitoring Parameter Definitions, page 15-4
- 15.5 Performance Monitoring for Electrical Cards, page 15-14
- 15.6 Performance Monitoring for Ethernet Cards, page 15-19
- 15.7 Performance Monitoring for Optical Cards, page 15-31
- 15.8 Performance Monitoring for the Fiber Channel Card, page 15-40

Note For information on PM parameters for Transponder and Muxponder cards, and DWDM cards, refer to Cisco ONS 15454 DWDM Reference Manual.

Note For additional information regarding PM parameters, refer to ITU G.826, and Telcordia documents GR-820-CORE, GR-499-CORE, and GR-253-CORE.

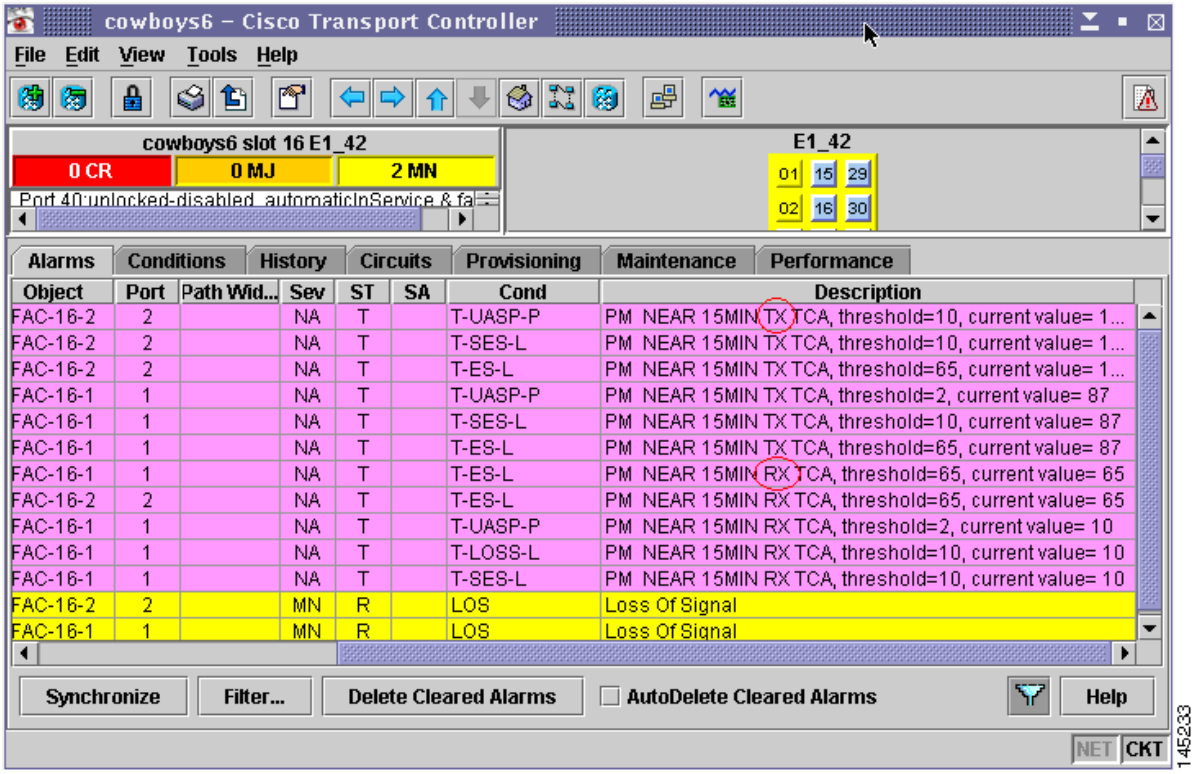
15.1 Threshold Performance Monitoring

Thresholds are used to set error levels for each PM parameter. You can set individual PM threshold values from the Cisco Transport Controller (CTC) card view Provisioning tab. For procedures on provisioning card thresholds, such as line, path, and SDH thresholds, refer to the *Cisco ONS 15454 SDH Procedure Guide*.

During the accumulation cycle, if the current value of a performance monitoring parameter reaches or exceeds its corresponding threshold value, a threshold crossing alert (TCA) is generated by the node and displayed by CTC. TCAs provide early detection of performance degradation. When a threshold is crossed, the node continues to count the errors during a given accumulation period. If 0 is entered as the threshold value, the performance monitoring parameter is disabled.

When TCAs occur, CTC displays them. An example is T-UASP-P in the **Cond** column, where the "T-" indicates a threshold crossing (Figure 15-1). In addition, for certain electrical cards, "RX" or "TX" is appended to the TCA description, as shown (see red circles). The RX indicates that the TCA is associated with the receive direction, and TX indicates the TCA is associated with the transmit direction.

Figure 15-1 TCAs Displayed in CTC


cowboys6 – Cisco Transport Controller
File Edit View Tools Help
cowboys6 slot 16 E1_42
0 CR
0 MJ
2 MN
E1_42
Alarms Conditions History Circuits Provisioning Maintenance Performance
Object Port Path Wid... Sev ST SA Cond Description
FAC-16-2 2 NA T T-UASP-P PM NEAR 15MIN TX TCA, threshold=10, current value= 1...
FAC-16-2 2 NA T T-SES-L PM NEAR 15MIN TX TCA, threshold=10, current value= 1...
FAC-16-2 2 NA T T-ES-L PM NEAR 15MIN TX TCA, threshold=65, current value= 1...
FAC-16-1 1 NA T T-UASP-P PM NEAR 15MIN TX TCA, threshold=2, current value= 87
FAC-16-1 1 NA T T-SES-L PM NEAR 15MIN TX TCA, threshold=10, current value= 87
FAC-16-1 1 NA T T-ES-L PM NEAR 15MIN TX TCA, threshold=65, current value= 87
FAC-16-1 1 NA T T-ES-L PM NEAR 15MIN RX TCA, threshold=65, current value= 65
FAC-16-2 2 NA T T-ES-L PM NEAR 15MIN RX TCA, threshold=65, current value= 65
FAC-16-1 1 NA T T-UASP-P PM NEAR 15MIN RX TCA, threshold=2, current value= 10
FAC-16-1 1 NA T T-LOSS-L PM NEAR 15MIN RX TCA, threshold=10, current value= 10
FAC-16-1 1 NA T T-SES-L PM NEAR 15MIN RX TCA, threshold=10, current value= 10
FAC-16-2 2 MN R LOS Loss Of Signal
FAC-16-1 1 MN R LOS Loss Of Signal
Synchronize
Filter...
Delete Cleared Alarms
AutoDelete Cleared Alarms
Help
NET CKT
145233

The ONS 15454 SDH electrical cards for which RX and TX are detected and appended to the TCA descriptions are shown in Table 15-1.

Table 15-1 Electrical Cards that Report RX and TX Direction for TCAs

Card	Line				Path			
	Near End		Far End		Near End		Far End	
	RX	TX	RX	TX	RX	TX	RX	TX
E1-42	YES	—	—	—	YES	YES	—	—

Note Due to limitations of memory and the number of TCAs generated by different platforms, you can manually add or modify the following two properties to their property file (CTC.INI for Windows and .ctcrc for UNIX) to fit the need:
ctc.15xxx.node.tr.lowater=yyy (where xxx is the platform and yyy is the number of the lowater mark. The default lowater mark is 25.)
ctc.15xxx.node.tr.hiwater=yyy (where xxx is the platform and yyy is the number of the hiwater mark. The default hiwater mark is 50.)
If the number of incoming TCA is greater than the hiwater mark, it will keep the latest lowater mark and discard older ones.

Change the threshold if the default value does not satisfy your error monitoring needs. For example, customers with a critical E1 installed for 911 calls must guarantee the best quality of service on the line; therefore, they lower all thresholds so that the slightest error raises a TCA.

15.2 Intermediate-Path Performance Monitoring

Intermediate-path performance monitoring (IPPM) allows transparent monitoring of a constituent channel of an incoming transmission signal by a node that does not terminate that channel. Many large ONS 15454 SDH networks only use line terminating equipment (LTE), not path terminating equipment (PTE). Table 15-2 shows ONS 15454 SDH cards that are considered LTE.

Table 15-2 Line Terminating Equipment (LTE)

Electrical LTE	
STM1E-12	—
Optical LTE	
OC3 IR 4/STM1 SH 1310	OC3 IR/STM1 SH 1310-8
OC12 IR/STM4 SH1310	OC12 LR/STM4 LH1310
OC12 LR/STM4 LH 1550	OC12 IR/STM4 SH 1310-4
OC48 IR/STM16 SH AS 1310	OC48 LR/STM16 LH AS 1550
OC48 ELR/STM16 EH 100 GHz	OC192 SR/STM64 IO 1310
OC192 IR/STM64 SH 1550	OC192 LR/STM64 LH 1550
OC192 LR/STM64 LH ITU 15xx.xx	—

Software Release 3.0 (R3.0) and later allow LTE cards to monitor near-end PM data on individual high-order paths by enabling IPPM. After enabling IPPM provisioning on the line card, service providers can monitor high-order paths that are configured in pass-through mode on an ONS 15454 SDH operating in SDH AU4 mode, thus making troubleshooting and maintenance activities more efficient.

IPPM occurs only on high-order paths that have IPPM enabled, and TCAs are raised only for PM parameters on the IPPM enabled paths. The monitored IPPM parameters are HP-EB, HP-BBE, HP-ES, HP-SES, HP-UAS, HP-ESR, HP-SESR, and HP-BBER.

Note The E1 card and STM-1 card can monitor far-end IPPM. For all other cards listed in Table 15-2, far-end IPPM is not supported. However, SDH path PM parameters can be monitored by logging into the far-end node directly.

The ONS 15454 SDH performs IPPM by examining the overhead in the monitored path and by reading all of the near-end path PM values in the incoming direction of transmission. The IPPM process allows the path signal to pass bidirectionally through the node completely unaltered.

For detailed information about specific IPPM parameters, locate the card name in the following sections and review the appropriate definition.

15.3 Pointer Justification Count Performance Monitoring

Pointers are used to compensate for frequency and phase variations. Pointer justification counts indicate timing errors on SDH networks. When a network is out of synchronization, jitter and wander occur on the transported signal. Excessive wander can cause terminating equipment to slip.

Slips cause different effects in service. Voice service has intermittent audible clicks. Compressed voice technology has short transmission errors or dropped calls. Fax machines lose scanned lines or experience dropped calls. Digital video transmission has distorted pictures or frozen frames. Encryption service loses the encryption key causing data to be transmitted again.

Pointers provide a way to align the phase variations in VC4 payloads. The VC4 payload pointer is located in the H1 and H2 bytes of the AU pointers section and is a count of the number of bytes the VC4 path overhead (POH) J1 byte is away from the H3 byte, not including the section overhead bytes. Clocking differences are measured by the offset in bytes from the pointer to the first byte of the VC4 POH called the J1 byte. Clocking differences that exceed the normal range of 0 to 782 can cause data loss.

There are positive (PPJC) and negative (NPJC) pointer justification count parameters. PPJC is a count of path-detected (PPJC-Pdet) or path-generated (PPJC-Pgen) positive pointer justifications. NPJC is a count of path-detected (NPJC-Pdet) or path-generated (NPJC-Pgen) negative pointer justifications depending on the specific PM name.

A consistent pointer justification count indicates clock synchronization problems between nodes. A difference between the counts means the node transmitting the original pointer justification has timing variations with the node detecting and transmitting this count. Positive pointer adjustments occur when the frame rate of the POH is too slow in relation to the rate of the VC4.

You must enable PPJC and NPJC performance monitoring parameters for LTE cards. See Table 15-2 on page 15-3 for a list of Cisco ONS 15454 SDH LTE cards. In CTC, the count fields for PPJC and NPJC PM parameters appear white and blank unless they are enabled on the card view Provisioning tab.

For detailed information about specific pointer justification count PM parameters, locate the card name in the following sections and review the appropriate definition.

15.4 Performance Monitoring Parameter Definitions

Table 15-3 gives definitions for each type of performance monitoring parameter found in this chapter.

Table 15-3 Performance Monitoring Parameters

Parameter	Definition
AISS-P	AIS Seconds Path (AISS-P) is a count of one-second intervals containing one or more alarm indication signal (AIS) defects.
BBE	Path Background Block Error (BBE) is an errored block not occurring as part of a severely errored second (SES).
BBE-PM	Path Monitoring Background Block Errors (BBE-PM) indicates the number of background block errors recorded in the optical transfer network (OTN) path during the PM time interval.
BBER	Path Background Block Error Ratio (BBER) is the ratio of BBE to total blocks in available time during a fixed measurement interval. The count of total blocks excludes all blocks during SESs.
BBER-PM	Path Monitoring Background Block Errors Ratio (BBER-PM) indicates the background block errors ratio recorded in the OTN path during the PM time interval.
BBER-SM	Section Monitoring Background Block Errors Ratio (BBER-SM) indicates the background block errors ratio recorded in the OTN section during the PM time interval.
BBE-SM	Section Monitoring Background Block Errors (BBE-SM) indicates the number of background block errors recorded in the optical transport network (OTN) section during the PM time interval.
BIE	The number of bit errors (BIE) corrected in the dense wavelength division multiplexing (DWDM) trunk line during the PM time interval.
BIEC	The number of Bit Errors Corrected (BIEC) in the DWDM trunk line during the PM time interval.
CGV	Code Group Violations (CGV) is a count of received code groups that do not contain a start or end delimiter.
CVCP-P	Code Violation Path (CVCP-P) is a count of CP-bit parity errors occurring in the accumulation period.
CVCP-PFE	Code Violation (CVCP-PFE) is a parameter that is counted when the three far-end block error (FEBE) bits in a M-frame are not all collectively set to 1.
CV-L	Code Violation Line (CV-L) indicates the number of coding violations occurring on the line. This parameter is a count of BPVs and EXZs occurring over the accumulation period.
CVP-P	Code Violation Path (CVP-P) is a code violation parameter for M23 applications. CVP-P is a count of P-bit parity errors occurring in the accumulation period.
DCG	Date Code Groups (DCG) is a count of received data code groups that do not contain ordered sets.
EB	Path Errored Block (EB) indicates that one or more bits are in error within a block.
ES	Path Errored Second (ES) is a one-second period with one or more errored blocks or at least one defect.

Table 15-3 Performance Monitoring Parameters (continued)

Parameter	Definition
ESCP-P	Errored Second Path (ESCP-P) is a count of seconds containing one or more CP-bit parity errors, one or more severely errored framing (SEF) defects, or one or more AIS defects. ESCP-P is defined for the C-bit parity application.
ESCP-PFE	Far-End Errored Second CP-bit Path (ESCP-PFE) is a count of one-second intervals containing one or more M-frames with the three FEBE bits not all collectively set to 1 or one or more far-end SEF/AIS defects.
ES-L	Errored Seconds Line (ES-L) is a count of the seconds containing one or more anomalies (BPV + EXZ) and/or defects (loss of signal) on the line.
ES-P	Path Errored Second (ES-P) is a one-second period with at least one defect.
ES-PM	Path Monitoring Errored Seconds (ES-PM) indicates the errored seconds recorded in the OTN path during the PM time interval.
ESP-P	Errored Second Path (ESP-P) is a count of seconds containing one or more P-bit parity errors, one or more SEF defects, or one or more AIS defects.
ESR	Path Errored Second Ratio (ESR) is the ratio of errored seconds to total seconds in available time during a fixed measurement interval.
ESR-P	Path Errored Second Ratio (ESR-P) is the ratio of errored seconds to total seconds in available time during a fixed measurement interval.
ESR-PM	Path Monitoring Errored Seconds Ratio (ESR-PM) indicates the errored seconds ratio recorded in the OTN path during the PM time interval.
ESR-SM	Section Monitoring Errored Seconds Ratio (ESR-SM) indicates the errored seconds ratio recorded in the OTN section during the PM time interval.
ES-SM	Section Monitoring Errored Seconds (ES-SM) indicates the errored seconds recorded in the OTN section during the PM time interval.
FC-PM	Path Monitoring Failure Counts (FC-PM) indicates the failure counts recorded in the OTN path during the PM time interval.
FC-SM	Section Monitoring Failure Counts (FC-SM) indicates the failure counts recorded in the OTN section during the PM time interval.
HP-BBE	High-Order Path Background Block Error (HP-BBE) is an errored block not occurring as part of an SES.
HP-BBER	High-Order Path Background Block Error Ratio (HP-BBER) is the ratio of BBE to total blocks in available time during a fixed measurement interval. The count of total blocks excludes all blocks during SESs.
HP-EB	High-Order Path Errored Block (HP-EB) indicates that one or more bits are in error within a block.
HP-ES	High-Order Path Errored Second (HP-ES) is a one-second period with one or more errored blocks or at least one defect.
HP-ESR	High-Order Path Errored Second Ratio (HP-ESR) is the ratio of errored seconds to total seconds in available time during a fixed measurement interval.
HP-NPJC-Pdet	High-Order, Negative Pointer Justification Count, Path Detected (HP-NPJC-Pdet) is a count of the negative pointer justifications detected on a particular path on an incoming SDH signal.

Table 15-3 Performance Monitoring Parameters (continued)

Parameter	Definition
HP-NPJC-Pdet	High-Order Path Negative Pointer Justification Count, Path Detected (HP-NPJC-Pdet) is a count of the negative pointer justifications detected on a particular path on an incoming SDH signal.
HP-NPJC-Pgen	High-Order, Negative Pointer Justification Count, Path Generated (HP-NPJC-Pgen) is a count of the negative pointer justifications generated for a particular path.
HP-PJCDiff	High-Order Path Pointer Justification Count Difference (HP-PJCDiff) is the absolute value of the difference between the total number of detected pointer justification counts and the total number of generated pointer justification counts. That is, HP-PJCDiff is equal to (HP-PPJC-PGen – HP-NPJC-PGen) – (HP-PPJC-PDet – HP-NPJC-PDet).
HP-PJCS-Pdet	High-Order Path Pointer Justification Count Seconds (HP-PJCS-PDet) is a count of the one-second intervals containing one or more HP-PPJC-PDet or HP-NPJC-PDet.
HP-PJCS-Pgen	High-Order Path Pointer Justification Count Seconds (HP-PJCS-PGen) is a count of the one-second intervals containing one or more HP-PPJC-PGen or HP-NPJC-PGen.
HP-PPJC-Pdet	High-Order, Positive Pointer Justification Count, Path Detected (HP-PPJC-Pdet) is a count of the positive pointer justifications detected on a particular path on an incoming SDH signal.
HP-PPJC-Pgen	High-Order, Positive Pointer Justification Count, Path Generated (HP-PPJC-Pgen) is a count of the positive pointer justifications generated for a particular path.
HP-SES	High-Order Path Severely Errored Seconds (HP-SES) is a one-second period containing 30 percent or more errored blocks or at least one defect. SES is a subset of ES.
HP-SESR	High-Order Path Severely Errored Second Ratio (HP-SESR) is the ratio of SES to total seconds in available time during a fixed measurement interval.
HP-UAS	High-Order Path Unavailable Seconds (HP-UAS) is a count of the seconds when the VC path was unavailable. A high-order path becomes unavailable when ten consecutive seconds occur that qualify as HP-SESs, and it continues to be unavailable until ten consecutive seconds occur that do not qualify as HP-SESs.
IOS	Idle Ordered Sets (IOS) is a count of received packets containing idle ordered sets.
IPC	A count of received packets that contain errored data code groups that have start and end delimiters.
LBC-MIN	LBC-MIN is the minimum percentage of Laser Bias Current.
LBC-AVG	Laser Bias Current—Average (LBC-AVG) is the average percentage of laser bias current.
LBC-MAX	Laser Bias Current—Maximum (LBC-MAX) is the maximum percentage of laser bias current.
LBC-MIN	Laser Bias Current—Minimum (LBC-MIN) is the minimum percentage of laser bias current.

Table 15-3 Performance Monitoring Parameters (continued)

Parameter	Definition
LOSS-L	Line Loss of Signal Seconds (LOSS-L) is a count of one-second intervals containing one or more LOS defects.
LP-BBE	Low-Order Path Background Block Error (LP-BBE) is an errored block not occurring as part of an SES.
LP-BBER	Low-Order Path Background Block Error Ratio (LP-BBER) is the ratio of BBE to total blocks in available time during a fixed measurement interval. The count of total blocks excludes all blocks during SESs.
LP-EB	Low-Order Path Errored Block (LP-EB) indicates that one or more bits are in error within a block.
LP-ES	Low-Order Path Errored Second (LP-ES) is a one-second period with one or more errored blocks or at least one defect.
LP-ESR	Low-Order Path Errored Second Ratio (LP-ESR) is the ratio of errored seconds to total seconds in available time during a fixed measurement interval.
LP-SES	Low-Order Path Severely Errored Seconds (LP-SES) is a one-second period containing greater than or equal to 30 percent errored blocks or at least one defect. SES is a subset of ES.
LP-SESR	Low-Order Path Severely Errored Second Ratio (LP-SESR) is the ratio of SES to total seconds in available time during a fixed measurement interval.
LP-UAS	Low-Order Path Unavailable Seconds (LP-UAS) is a count of the seconds when the VC path was unavailable. A low-order path becomes unavailable when ten consecutive seconds occur that qualify as LP-SESs, and it continues to be unavailable until ten consecutive seconds occur that do not qualify as LP-SESs.
MS-BBE	Multiplex Section Background Block Error (MS-BBE) is an errored block not occurring as part of an SES.
MS-BBER	Multiplex Section Background Block Error Ratio (MS-BBER) is the ratio of BBE to total blocks in available time during a fixed measurement interval. The count of total blocks excludes all blocks during SESs.
MS-EB	Multiplex Section Errored Block (MS-EB) indicates that one or more bits are in error within a block.
MS-ES	Multiplex Section Errored Second (MS-ES) is a one-second period with one or more errored blocks or at least one defect.
MS-ESR	Multiplex Section Errored Second Ratio (MS-ESR) is the ratio of errored seconds to total seconds in available time during a fixed measurement interval.
MS-NPJC-Pgen	Multiplex Section Negative Pointer Justification Count, Path Generated (MS-NPJC-Pgen) is a count of the negative pointer justifications generated for a particular path.
MS-PPJC-Pgen	Multiplex Section Positive Pointer Justification Count, Path Generated (MS-PPJC-Pgen) is a count of the positive pointer justifications generated for a particular path.

Table 15-3 Performance Monitoring Parameters (continued)

Parameter	Definition
MS-PSC (1+1 protection)	In a 1+1 protection scheme for a working card, Multiplex Section Protection Switching Count (MS-PSC) is a count of the number of times service switches from a working card to a protection card plus the number of times service switches back to the working card. For a protection card, MS-PSC is a count of the number of times service switches to a working card from a protection card plus the number of times service switches back to the protection card. The MS-PSC PM is only applicable if revertive line-level protection switching is used.
MS-PSC[1] (MS-SPRing)	For a protect line in a two-fiber multiplex section-shared protection ring (MS-SPRing), Multiplex Section Protection Switching Count (MS-PSC) refers to the number of times a protection switch has occurred either to a particular span's line protection or away from a particular span's line protection. Therefore, if a protection switch occurs on a two-fiber MS-SPRing, the MS-PSC of the protection span to which the traffic is switched will increment, and when the switched traffic returns to its original working span from the protect span, the MS-PSC of the protect span will increment again.
MS-PSC-R[1]	In a four-fiber MS-SPRing, Multiplex Section Protection Switching Count-Ring (MS-PSC-R) is a count of the number of times service switches from a working line to a protection line plus the number of times it switches back to a working line. A count is only incremented if ring switching is used.
MS-PSC-S	In a four-fiber MS-SPRing, Multiplex Section Protection Switching Count-Span (MS-PSC-S) is a count of the number of times service switches from a working line to a protection line plus the number of times it switches back to the working line. A count is only incremented if span switching is used.
MS-PSC-W	For a working line in a two-fiber MS-SPRing, Multiplex Section Protection Switching Count-Working (MS-PSC-W) is a count of the number of times traffic switches away from the working capacity in the failed line and back to the working capacity after the failure is cleared. MS-PSC-W increments on the failed working line and MS-PSC increments on the active protect line. For a working line in a four-fiber MS-SPRing, MS-PSC-W is a count of the number of times service switches from a working line to a protection line plus the number of times it switches back to the working line. MS-PSC-W increments on the failed line and MS-PSC-R or MS-PSC-S increments on the active protect line.
MS-PSD	Multiplex Section Protection Switching Duration (MS-PSD) applies to the length of time, in seconds, that service is carried on another line. For a working line, MS-PSD is a count of the number of seconds that service was carried on the protection line. For the protection line, MS-PSD is a count of the seconds that the line was used to carry service. The MS-PSD PM is only applicable if revertive line-level protection switching is used. MS-PSD increments on the active protect line and MS-PSD-W increments on the failed working line.

Table 15-3 Performance Monitoring Parameters (continued)

Parameter	Definition
MS-PSD-R	In a four-fiber MS-SPRing, Multiplex Section Protection Switching Duration-Ring (MS-PSD-R) is a count of the seconds that the protection line was used to carry service. A count is only incremented if ring switching is used.
MS-PSD-S	In a four-fiber MS-SPRing, Multiplex Section Protection Switching Duration-Span (MS-PSD-S) is a count of the seconds that the protection line was used to carry service. A count is only incremented if span switching is used.
MS-PSD-W	For a working line in a two-fiber MS-SPRing, Multiplex Section Protection Switching Duration-Working (MS-PSD-W) is a count of the number of seconds that service was carried on the protection line. MS-PSD-W increments on the failed working line and PSD increments on the active protect line.
MS-SES	Multiplex Section Severely Errored Second (MS-SES) is a one-second period which contains 30 percent or more errored blocks or at least one defect. SES is a subset of ES. For more information, refer to ITU-T G.829 Section 5.1.3.
MS-SESR	Multiplex Section Severely Errored Second ratio (MS-SESR) is the ratio of SES to total seconds in available time during a fixed measurement interval.
MS-UAS	Multiplex Section Unavailable Seconds (MS-UAS) is a count of the seconds when the section was unavailable. A section becomes unavailable when ten consecutive seconds occur that qualify as MS-SESs, and it continues to be unavailable until ten consecutive seconds occur that do not qualify as MS-SESs. When the condition is entered, MS-SESs decrement and then count toward MS-UAS.
NIOS	Non-Idle Ordered Sets (NIOS) is a count of received packets containing non-idle ordered sets.
OPR	Optical Power Received (OPR) is the measure of average optical power received as a percentage of the nominal OPT.
OPR-AVG	Average Receive Optical Power (dBm).
OPR-MAX	Maximum Receive Optical Power (dBm).
OPR-MIN	Minimum Receive Optical Power (dBm).
OPT	Optical Power Transmitted (OPT) is the measure of average optical power transmitted as a percentage of the nominal OPT.
OPT-AVG	Average Transmit Optical Power (dBm).
OPT-MAX	Maximum Transmit Optical Power (dBm).
OPT-MIN	Minimum Transmit Optical Power (dBm).
RS-BBE	Regenerator Section Background Block Error (RS-BBE) is an errored block not occurring as part of an SES.
RS-BBER	Regenerator Section Background Block Error Ratio (RS-BBER) is the ratio of BBE to total blocks in available time during a fixed measurement interval. The count of total blocks excludes all blocks during SESs.

Table 15-3 Performance Monitoring Parameters (continued)

Parameter	Definition
RS-EB	Regenerator Section Errored Block (RS-EB) indicates that one or more bits are in error within a block.
RS-ES	Regenerator Section Errored Second (RS-ES) is a one-second period with one or more errored blocks or at least one defect.
RS-ESR	Regenerator Section Errored Second Ratio (RS-ESR) is the ratio of errored seconds to total seconds in available time during a fixed measurement interval.
RS-SES	Regenerator Section Severely Errored Second (RS-SES) is a one-second period which contains 30 percent or more errored blocks or at least one defect. SES is a subset of ES.
RS-SESR	Regenerator Section Severely Errored Second Ratio (RS-SESR) is the ratio of SES to total seconds in available time during a fixed measurement interval.
RS-UAS	Regenerator Section Unavailable Second (RS-UAS) is a count of the seconds when the regenerator section was unavailable. A section becomes unavailable when ten consecutive seconds occur that qualify as RS-UASs, and it continues to be unavailable until ten consecutive seconds occur that do not qualify as RS-UASs.
Rx AISS-P	Receive Path Alarm Indication Signal Seconds (AISS-P) means that an alarm indication signal occurred on the receive end of the path. This parameter is a count of seconds containing one or more AIS defects.
Rx BBE-P	Receive Path Background Block Error (BBE-P) is an errored block not occurring as part of an SES.
Rx EB-P	Receive Path Errored Block (EB-P) indicates that one or more bits are in error within a block.
Rx ES-P	Receive Path Errored Second (ES-P) is a one-second period with one or more errored blocks or at least one defect.
Rx ESR-P	Receive Path Errored Second Ratio (ESR-P) is the ratio of errored seconds to total seconds in available time during a fixed measurement interval.
Rx SES-P	Receive Path Severely Errored Seconds (SES-P) is a one-second period containing 30 percent or more errored blocks or at least one defect; SES is a subset of ES.
Rx SESR-P	Receive Path Severely Errored Second Ratio (SESR-P) is the ratio of SES to total seconds in available time during a fixed measurement interval.
Rx UAS-P	Receive Path Unavailable Seconds (UAS-P) is a count of one-second intervals when the E-1 path is unavailable on the signal receive end. The E-1 path is unavailable when ten consecutive SESs occur. The ten SESs are included in unavailable time. After the E-1 path becomes unavailable, it becomes available when ten consecutive seconds occur with no SESs. The ten seconds with no SESs are excluded from unavailable time.
Rx BBER-P	Receive Path Background Block Error Ratio (BBER-P) is the ratio of BBE to total blocks in available time during a fixed measurement interval. The count of total blocks excludes all blocks during SESs.

Table 15-3 Performance Monitoring Parameters (continued)

Parameter	Definition
SASCP-P	SEF/AIS Second (SASCP-P) is a count of one-second intervals containing one or more near-end SEF/AIS defects.
SASP-P	SEF/AIS Seconds Path (SASP-P) is a count of one-second intervals containing one or more SEFs or one or more AIS defects on the path.
SES	Severely Errored Seconds (SES) is a one-second period containing 30 percent or more errored blocks or at least one defect. SES is a subset of ES.
SESCP-P	Severely Errored Seconds CP-bit Path (SESCP-P) is a count of seconds containing more than 44 CP-bit parity errors, one or more SEF defects, or one or more AIS defects.
SESCP-PFE	Severely Errored Seconds CP-bit Path Far End (SESCP-PFE) is a count of one-second intervals containing one or more 44 M-frames with the three FEBE bits not all collectively set to 1, or with one or more far-end SEF/AIS defects.
SES-L	Severely Errored Seconds Line (SES-L) is a count of the seconds containing more than a particular quantity of anomalies (BPV + EXZ $\geq$ 44) and/or defects on the line.
SES-P	Severely Errored Seconds Path (SES-P) is a one-second period containing at least one defect. SES-P is a subset of ES-P.
SES-PFE	Far-End Path Severely Errored Seconds (SES-PFE) is a one-second period containing at least one defect. SES-PFE is a subset of ES-PFE.
SES-PM	Path Monitoring Severely Errored Seconds (SES-PM) indicates the severely errored seconds recorded in the OTN path during the PM time interval.
SESP-P	Severely Errored Seconds Path (SESP-P) is a count of seconds containing more than 44 P-bit parity violations, one or more SEF defects, or one or more AIS defects.
SESR-P	Path Severely Errored Second Ratio (SESR-P) is the ratio of SES to total seconds in available time during a fixed measurement interval.
SESR-PM	Path Monitoring Severely Errored Seconds Ratio (SESR-PM) indicates the severely errored seconds ratio recorded in the OTN path during the PM time interval.
SES-SM	Section Monitoring Severely Errored Seconds (SES-SM) indicates the severely errored seconds recorded in the OTN section during the PM time interval.
Tx AISS-P	Transmit Path Alarm Indication Signal (AISS-P) means that an alarm indication signal occurred on the transmit end of the path. This parameter is a count of seconds containing one or more AIS defects.
Tx BBE-P	Transmit Path Background Block Error (BBE-P) is an errored block not occurring as part of an SES.
Tx ES-P	Transmit Path Errored Second (ES-P) is a one-second period with one or more errored blocks or at least one defect.
Tx ESR-P	Transmit Path Errored Second Ratio (ESR-P) is the ratio of errored seconds to total seconds in available time during a fixed measurement interval.

Table 15-3 Performance Monitoring Parameters (continued)

Parameter	Definition
Tx SES-P	Transmit Path Severely Errored Seconds (SES-P) is a one-second period containing 30 percent or more errored blocks or at least one defect; SES is a subset of ES.
Tx SESR-P	Transmit Path Severely Errored Second Ratio (SESR-P) is the ratio of SES to total seconds in available time during a fixed measurement interval.
Tx UAS-P	Transmit Path Unavailable Seconds (UAS-P) is a count of one-second intervals when the E-1 path is unavailable on the transmit end of the signal. The E-1 path is unavailable when ten consecutive SESs occur. The ten SESs are included in unavailable time. After the E-1 path becomes unavailable, it becomes available when ten consecutive seconds occur with no SESs. The ten seconds with no SESs are excluded from unavailable time.
Tx BBER-P	Transmit Path Background Block Error Ratio (BBER-P) is the ratio of BBE to total blocks in available time during a fixed measurement interval. The count of total blocks excludes all blocks during SESs.
Tx EB-P	Transmit Path Errored Block (EB-P) indicates that one or more bits are in error within a block.
UAS	Path Unavailable Seconds (UAS) is a count of the seconds when the VC path was unavailable. A high-order path becomes unavailable when ten consecutive seconds occur that qualify as HP-SESs, and it continues to be unavailable until ten consecutive seconds occur that do not qualify as HP-SESs.
UASCP-P	Unavailable Seconds CP-bit Path (UASCP-P) is a count of one-second intervals when the DS-3 path is unavailable. A DS-3 path becomes unavailable when ten consecutive SESCP-Ps occur. The ten SESCP-Ps are included in unavailable time. After the DS-3 path becomes unavailable, it becomes available when ten consecutive seconds with no SESCP-Ps occur. The ten seconds with no SESCP-Ps are excluded from unavailable time.
UASCP-PFE	Unavailable Seconds CP-bit Far End Path (UASCP-PFE) is a count of one-second intervals when the DS-3 path becomes unavailable. A DS-3 path becomes unavailable when ten consecutive far-end CP-bit SESs occur. The ten CP-bit SESs are included in unavailable time. After the DS-3 path becomes unavailable, it becomes available when ten consecutive seconds occur with no CP-bit SESs. The ten seconds with no CP-bit SESs are excluded from unavailable time.
UAS-P	Path Unavailable Seconds (UAS-P) is a count of the seconds when the path was unavailable. A path becomes unavailable when ten consecutive seconds occur that qualify as P-SESs, and it continues to be unavailable until ten consecutive seconds occur that do not qualify as P-SESs.
UAS-PFE	Far-End Path Unavailable Seconds (UAS-PFE) is a count of the seconds when the path was unavailable. A path becomes unavailable when ten consecutive seconds occur that qualify as P-SESs, and it continues to be unavailable until ten consecutive seconds occur that do not qualify as P-SESs.
UAS-PM	Path Monitoring Unavailable Seconds (UAS-PM) indicates the unavailable seconds recorded in the OTN path during the PM time interval.

Table 15-3 Performance Monitoring Parameters (continued)

Parameter	Definition
UASP-P	Unavailable Second Path (UASP-P) is a count of one-second intervals when the DS-3 path is unavailable. A DS3 path becomes unavailable when ten consecutive SESP-Ps occur. The ten SESP-Ps are included in unavailable time. After the DS-3 path becomes unavailable, it becomes available when ten consecutive seconds with no SESP-Ps occur. The ten seconds with no SESP-Ps are excluded from unavailable time.
UAS-SM	Section Monitoring Unavailable Seconds (UAS-SM) indicates the unavailable seconds recorded in the OTN section during the PM time interval.
UNC-WORDS	The number of uncorrectable words detected in the DWDM trunk line during the PM time interval.
VPC	A count of received packets that contain non-errored data code groups that have start and end delimiters.

1. 4-fiber MS-SPRing is not supported on the STM-4 and STM4 SH 1310-4 cards; therefore, the MS-PSC-S and MS-PSC-R PM parameters do not increment.

15.5 Performance Monitoring for Electrical Cards

The following sections define performance monitoring parameters for the E1-N-14, E1-42, E3-12, and DS3i-N-12 electrical cards.

15.5.1 E1-N-14 Card and E1-42 Card Performance Monitoring Parameters

Figure 15-2 shows the signal types that support near-end and far-end PM parameters for the E1-N-14 card and the E1-42 card.

Figure 15-2 Monitored Signal Types for the E1-N-14 Card and E1-42 Card

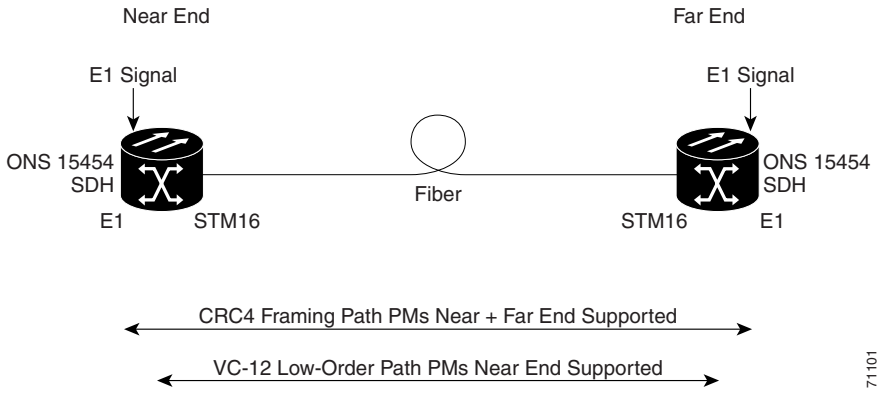
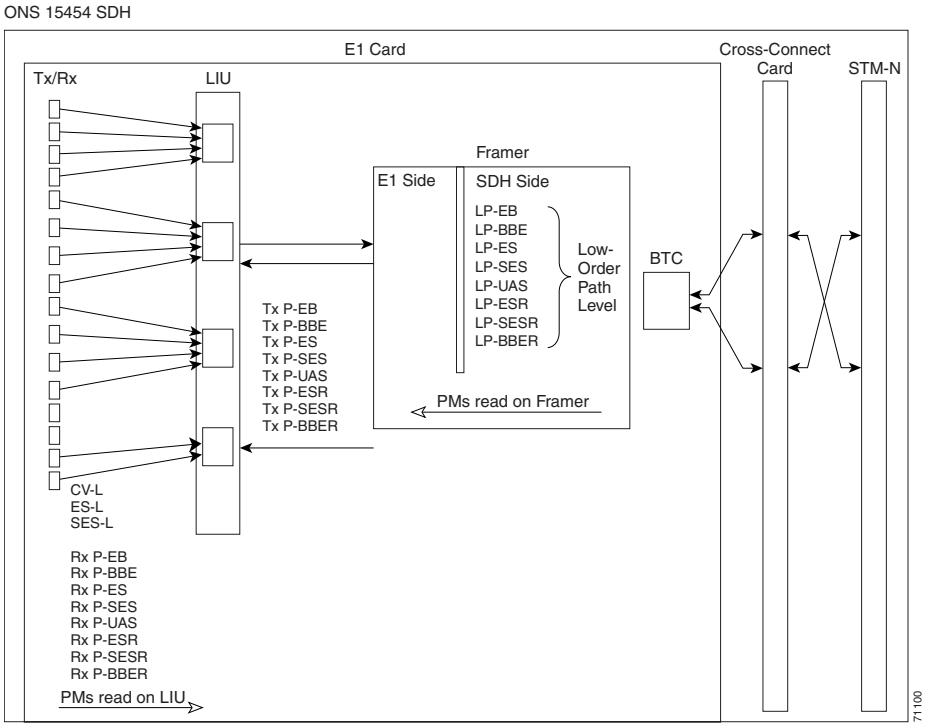


Figure 15-3 shows where overhead bytes detected on the application-specific integrated circuits (ASICs) produce performance monitoring parameters for the E1-N-14 card.

Note The E1-42 card uses the same PM read points. The only difference from Figure 15-3 is that the number of ports on the E1-42 equal 42.

Figure 15-3 PM Read Points on the E1-N-14 Card



The PM parameters for the E1-N-14 card and E1-42 card are listed in Table 15-4. The parameters are defined in Table 15-3 on page 15-5.

Table 15-4 PM Parameters for the E1-N-14 Card and E1-42 Card

Line (NE)[1]	Tx/Rx Path (NE)[2, 3]	VC12 LP (NE/FE)	Tx/Rx Path (FE)[2 3]
CV-L	AISS-P	LP-EB	AISS-PFE
ES-L	BBE-P	LP-ES	BBE-PFE
SES-L	BBER-P	LP-SES	BBER-PFE
LOSS-L	EB-P	LP-UAS	EB-PFE
	ES-P	LP-BBE	ES-PFE
	ESR-P	LP-ESR	ESR-PFE
	SES-P	LP-SESR	SES-PFE
	SESR-P	LP-BBER	SESR-PFE
	UAS-P		UAS-PFE

1. SDH path PMs do not increment unless IPPM is enabled. See the "15.2 Intermediate-Path Performance Monitoring" section on page 15-3.
2. Transmit and receive CEPT and CRC4 framing path PM parameters for the near-end and far-end E1-N-14 and E1-42 cards.
3. Under the Provisioning > Threshold tab, the E1-N-14 card and the E1-42 card have user-defined thresholds for the E-1 Rx path PM parameters. In the Threshold tab, they are displayed as EB, BBE, ES, SES, and UAS without the Rx prefix.

15.5.2 E3-12 Card Performance Monitoring Parameters

Figure 15-4 shows the signal types that support near-end and far-end PM parameters for the E3-12 card. Figure 15-5 shows where overhead bytes detected on the ASICs produce performance monitoring parameters for the E3-12 card.

Figure 15-4 Monitored Signal Types for the E3-12 Card

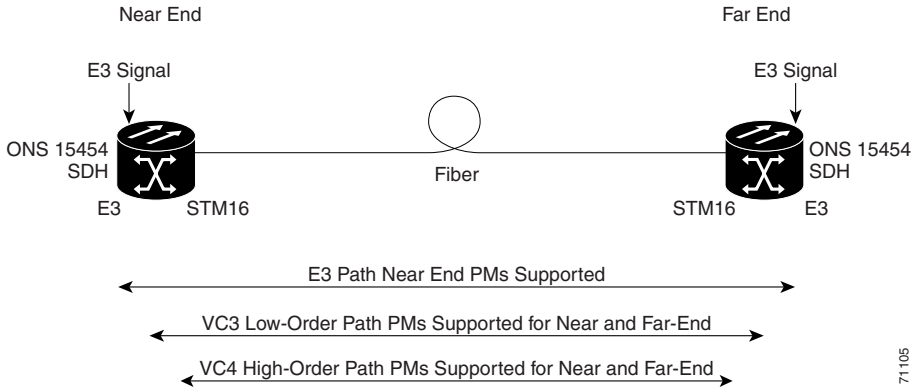
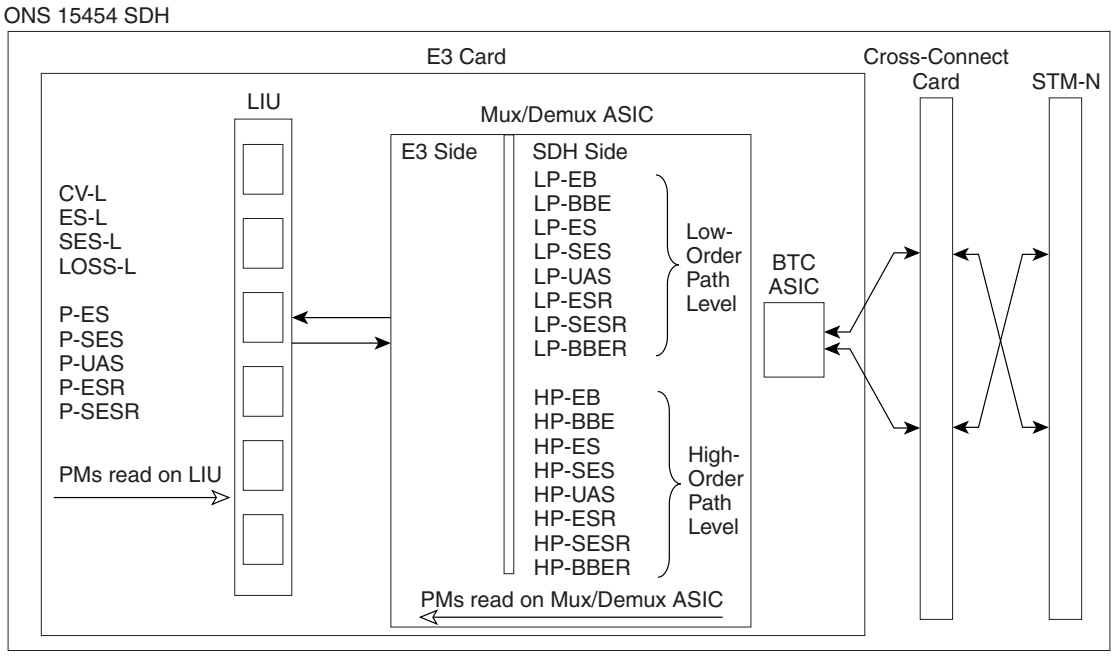


Figure 15-5 PM Read Points on the E3-12 Card



The PM parameters for the E3-12 card are listed in Table 15-5. The parameters are defined in Table 15-3 on page 15-5.

Table 15-5 PM Parameters for the E3-12 Card

Line (NE)	Path (NE)	VC3 Low-End Path (NE/FE)	VC4 HP Path (NE/FE)
CV-L	ES-P	LP-BBE	HP-BBE
ES-L	ESR-P	LP-BBER	HP-BBER
SES-L	SES-P	LP-EB	HP-EB
LOSS-L	SESR-P	LP-ES	HP-ES
	UAS-P	LP-ESR	HP-ESR
		LP-SES	HP-SES
		LP-SESR	HP-SESR
		LP-UAS	HP-UAS

15.5.3 DS3i-N-12 Card Performance Monitoring Parameters

Figure 15-6 shows the signal types that support near-end and far-end PM parameters for the DS3i-N-12 card. Figure 15-7 shows where overhead bytes detected on the ASICs produce performance monitoring parameters for the DS3i-N-12 card.

Figure 15-6 Monitored Signal Types for the DS3i-N-12 Card

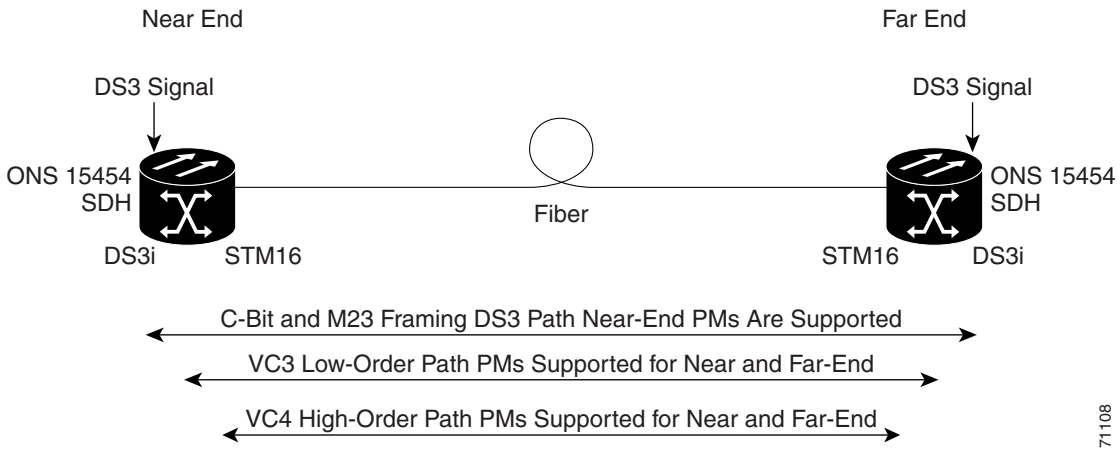
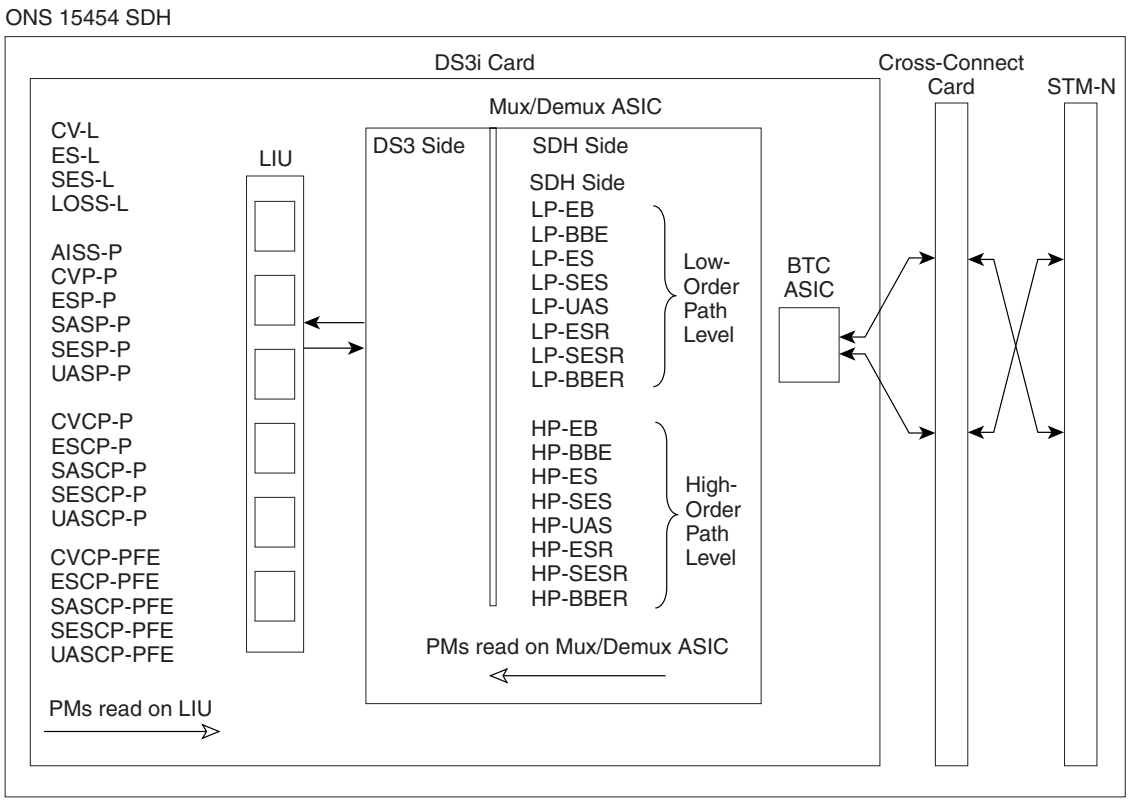


Figure 15-7 PM Read Points on the DS3i-N-12 Card



The PM parameters for the DS3i-N-12 card are listed in Table 15-6. The parameters are defined in Table 15-3 on page 15-5.

Table 15-6 DS3i-N-12 Card PMs

Line (NE)	Path (NE)[1, 2]	Path (FE)[1, 2]	VC3 Low-End Path (NE/FE)	VC4 HP Path (NE/FE)
CV-L	AISS-P	CVCP-PFE	LP-BBE	HP-BBE
ES-L	CVP-P	ESCP-PFE	LP-BBER	HP-BBER
SES-L	ESP-P	SASCP-PFE	LP-EB	HP-EB
LOSS-L	SASP-P[3]	SESCP-PFE	LP-ES	HP-ES
	SESP-P	UASCP-PFE	LP-ESR	HP-ESR
	UASP-P		LP-SES	HP-SES
	CVCP-P		LP-SESR	HP-SESR
	ESCP-P		LP-UAS	HP-UAS
	SASP-P			
	SESCP-P			
	UASCP-P			

1. C-Bit and M23 framing path PM parameters
2. The C-bit PMs (PMs that contain the text “CP-P”) are applicable only if line format is C-bit.
3. DS3i-N-12 cards support SAS-P only on the Rx path.

15.6 Performance Monitoring for Ethernet Cards

The following sections define performance monitoring parameters and definitions for the E-Series, G-Series, and ML-Series Ethernet cards.

15.6.1 E-Series Ethernet Card Performance Monitoring Parameters

CTC provides Ethernet performance information, including line-level parameters, port bandwidth consumption, and historical Ethernet statistics. The E-Series Ethernet performance information is divided into the Statistics, Utilization, and History tabbed windows within the card view Performance tab window. The following sections describe PM parameters provided for the E100T-G and E1000-2 Ethernet cards.

15.6.1.1 E-Series Ethernet Statistics Window

The Ethernet statistics window lists Ethernet parameters at the line level. The Statistics window provides buttons to change the statistical values shown. The Baseline button resets the displayed statistics values to zero. The Refresh button manually refreshes statistics. Auto-Refresh sets a time interval at which automatic refresh occurs.

Table 15-7 defines the E-Series Ethernet card statistics parameters.

Table 15-7 E-Series Ethernet Statistics Parameters

Parameter	Meaning
Link Status	Link integrity indicator (up means present, and down means not present).
Rx Packets	Number of packets received since the last counter reset.
Rx Bytes	Number of bytes received since the last counter reset.
Tx Packets	Number of packets transmitted since the last counter reset.
Tx Bytes	Number of bytes transmitted since the last counter reset.
Rx Total Errors	Total number of receive errors.
Rx FCS	Number of packets with a frame check sequence (FCS) error. FCS errors indicate frame corruption during transmission.
Rx Alignment	Number of packets with alignment errors (received incomplete frames).
Rx Runts	Measures undersized packets with bad cyclic redundancy check (CRC) errors.
Rx Shorts	Measures undersized packets with good CRC errors.
Rx Oversized + Jabbers	Measures oversized packets and jabbers. Size is greater than 1522 errors regardless of CRC errors.
Rx Giants	Number of packets received that are greater than 1518 bytes in length for untagged interfaces and 1522 bytes for tagged interfaces.
Tx Collisions	Number of transmit packets that are collisions; the port and the attached device transmitting at the same time caused collisions.
Tx Late Collisions	Number of frames that were not transmitted since they encountered a collision outside of the normal collision window. Normally, late collision events should occur only rarely, if at all.

Table 15-7 E-Series Ethernet Statistics Parameters (continued)

Parameter	Meaning
Tx Excessive Collisions	Number of consecutive collisions.
Tx Deferred	Number of packets deferred.

15.6.1.2 E-Series Ethernet Utilization Window

The Utilization window shows the percentage of transmit (Tx) and receive (Rx) line bandwidth used by the Ethernet ports during consecutive time segments. The Mode field displays the real-time mode status, such as "100 Full," which is the mode setting configured on the E-Series port. However, if the E-Series port is set to autonegotiate the mode (Auto), this field shows the result of the link negotiation between the E-Series and the peer Ethernet device attached directly to the E-Series port.

The Utilization window provides an Interval menu that enables you to set time intervals of 1 minute, 15 minutes, 1 hour, and 1 day. Line utilization is calculated with the following formulas:

Rx = (inOctets + inPkts * 20) * 8 / 100% interval * maxBaseRate

Tx = (outOctets + outPkts * 20) * 8 / 100% interval * maxBaseRate

The interval is defined in seconds. The maxBaseRate is defined by raw bits per second in one direction for the Ethernet port (that is, 1 Gbps). STS circuit maxBaseRates are shown in Table 15-8.

Table 15-8 MaxBaseRate for VC Circuits

STS	maxBaseRate
VC3	51840000
VC4	155000000
VC42C	311000000
VC44C	622000000

Note Line utilization numbers express the average of ingress and egress traffic as a percentage of capacity.

Note The E-Series Ethernet card is a Layer 2 device or switch and supports Trunk Utilization statistics. The Trunk Utilization statistics are similar to the Line Utilization statistics, but shows the percentage of circuit bandwidth used rather than the percentage of line bandwidth used. The Trunk Utilization statistics are accessed through the card view Maintenance tab.

15.6.1.3 E-Series Ethernet History Window

The Ethernet History window lists past Ethernet statistics for the previous time intervals. Depending on the selected time interval, the History window displays the statistics for each port for the number of previous time intervals as shown in Table 15-9. The parameters are defined in Table 15-7 on page 15-19.

Table 15-9 Ethernet Statistics History per Time Interval

Time Interval	Number of Intervals Displayed
1 minute	60 previous time intervals
15 minutes	32 previous time intervals
1 hour	24 previous time intervals
1 day (24 hours)	7 previous time intervals

15.6.2 G-Series Ethernet Card Performance Monitoring Parameters

CTC provides Ethernet performance information, including line-level parameters, port bandwidth consumption, and historical Ethernet statistics. The G-Series Ethernet performance information is divided into the Statistics, Utilization, and History tabbed windows within the card view Performance tab window. The following sections describe PM parameters provided for the G1000-4 and G1K-4 Ethernet cards.

15.6.2.1 G-Series Ethernet Statistics Window

The Ethernet Statistics window lists Ethernet parameters at the line level. The Statistics window provides buttons to change the statistical values shown. The Baseline button resets the displayed statistics values to zero. The Refresh button manually refreshes statistics. Auto-Refresh sets a time interval at which automatic refresh occurs. The G-Series Statistics window also has a Clear button. The Clear button sets the values on the card to zero, but does not reset the G-Series card.

Table 15-10 defines the G-Series Ethernet card statistics parameters.

Table 15-10 G-Series Ethernet Statistics Parameters

Parameter	Meaning
Time Last Cleared	A time stamp indicating the last time statistics were reset.
Link Status	Indicates whether the Ethernet link is receiving a valid Ethernet signal (carrier) from the attached Ethernet device; up means present, and down means not present.
Rx Packets	Number of packets received since the last counter reset.
Rx Bytes	Number of bytes received since the last counter reset.
Tx Packets	Number of packets transmitted since the last counter reset.
Tx Bytes	Number of bytes transmitted since the last counter reset.
Rx Total Errors	Total number of receive errors.
Rx FCS	Number of packets with a FCS error. FCS errors indicate frame corruption during transmission.
Rx Alignment	Number of packets with received incomplete frames.
Rx Runts	Measures undersized packets with bad CRC errors.
Rx Shorts	Measures undersized packets with good CRC errors.
Rx Jabbers	Total number of frames received that exceed the 1548-byte maximum and contain CRC errors.

Table 15-10 G-Series Ethernet Statistics Parameters (continued)

Parameter	Meaning
Rx Giants	Number of packets received that are greater than 1530 bytes in length.
Rx Pause Frames	Number of received Ethernet IEEE 802.3z pause frames.
Tx Pause Frames	Number of transmitted IEEE 802.3z pause frames.
Rx Pkts Dropped Internal Congestion	Number of received packets dropped due to overflow in G-Series frame buffer.
Tx Pkts Dropped Internal Congestion	Number of transmit queue drops due to drops in the G-Series frame buffer.
HDLC Errors	High-level data link control (HDLC) errors received from SDH/SONET. Do not use the HDLC errors counter to count the number of frames dropped because of HDLC errors, because each frame can fragment into several smaller frames during HDLC error conditions and spurious HDLC frames can also be generated. If HDLC error counters are incrementing when no SDH path problems should be present, it might indicate a problem with the quality of the SDH path. For example, a SDH protection switch generates a set of HLDC errors. But the actual values of these counters are less significant than the fact they are changing.
Rx Unicast Packets	Number of unicast packets received since the last counter reset.
Tx Unicast Packets	Number of unicast packets transmitted.
Rx Multicast Packets	Number of multicast packets received since the last counter reset.
Tx Multicast Packets	Number of multicast packets transmitted.
Rx Broadcast Packets	Number of broadcast packets received since the last counter reset.
Tx Broadcast Packets	Number or broadcast packets transmitted.

15.6.2.2 G-Series Ethernet Utilization Window

The Utilization window shows the percentage of Tx and R) line bandwidth used by the Ethernet ports during consecutive time segments. The Mode field displays the real-time mode status, such as “100 Full,” which is the mode setting configured on the G-Series port. However, if the G-Series port is set to autonegotiate the mode (Auto), this field shows the result of the link negotiation between the G-Series and the peer Ethernet device attached directly to the G-Series port.

The Utilization window provides an Interval menu that enables you to set time intervals of 1 minute, 15 minutes, 1 hour, and 1 day. Line utilization is calculated with the following formulas:

Rx = (inOctets + inPkts * 20) * 8 / 100% interval * maxBaseRate

Tx = (outOctets + outPkts * 20) * 8 / 100% interval * maxBaseRate

The interval is defined in seconds. The maxBaseRate is defined by raw bits per second in one direction for the Ethernet port (that is, 1 Gbps). The maxBaseRate for G-Series VC is shown in Table 15-8 on page 15-20.

Note Line utilization numbers express the average of ingress and egress traffic as a percentage of capacity.

Note Unlike E-Series cards, G-Series cards do not have a display of Trunk Utilization statistics, because G-Series cards are not Layer 2 devices.

15.6.2.3 G-Series Ethernet History Window

The Ethernet History window lists past Ethernet statistics for the previous time intervals. Depending on the selected time interval, the History window displays the statistics for each port for the number of previous time intervals as shown in Table 15-9. The parameters are defined in Table 15-10 on page 15-21.

15.6.3 ML-Series Ethernet Card Performance Monitoring Parameters

CTC provides Ethernet performance information for line-level parameters and historical Ethernet statistics. The ML-Series Ethernet performance information is divided into the Ether Ports and Packet over SONET/SDH (POS) Ports tabbed windows within the card view Performance tab window. The following sections describe PM parameters provided for the ML100T-12 and ML1000-2 Ethernet cards.

15.6.3.1 ML-Series Ether Ports Parameters

The Ether Ports window lists Ethernet PM parameter values for each Ethernet port on the card. Auto-Refresh sets a time interval at which automatic refresh will occur. The PM values are a snapshot captured at the time intervals selected in the Auto-Refresh field. Historical PM values are not stored or displayed.

Table 15-11 defines the ML-Series Ethernet card Ether Ports PM parameters.

Table 15-11 ML-Series Ether Ports PM Parameters

Parameter	Meaning
Link Status	Indicates whether the Ethernet link is receiving a valid Ethernet signal (carrier) from the attached Ethernet device; up means present, and down means not present.
ifInOctets	Indicates the number of bytes received since the last counter reset.
rxTotalPackets	Indicates the number of packets received.
ifInUcastPkts	Indicates the number of unicast packets received since the last counter reset.
ifInMulticast Pkts	Indicates the number of multicast packets received since the last counter reset.
ifInBroadcast Pkts	Indicates the number of broadcast packets received since the last counter reset.
ifInDiscards	Indicates the number of inbound packets which were chosen to discard, though no errors had been detected. This prevents them from moving to a higher-layer protocol. A possible reason for discarding such packets is to free up buffer space.
ifOutOctets	Indicates the number of bytes transmitted since the last counter reset.
txTotalPkts	Indicates the number of transmitted packets.

Table 15-11 ML-Series Ether Ports PM Parameters (continued)

Parameter	Meaning
ifOutUcast Pkts	Indicates the number of unicast packets transmitted.
ifOutMulticast Pkts	Indicates the number of multicast packets transmitted.
ifOutBroadcast Pkts	Indicates the number or broadcast packets transmitted.
dot3StatsAlignmentErrors	Indicates the count of frames received on a particular interface that are not an integral number of octets in length and do not pass the FCS check.
dot3StatsFCSErrors	Indicates the count of frames received on a particular interface that are an integral number of octets in length but do not pass the FCS check.
etherStatsUndersizePkts	Indicates the total number of packets received that were less than 64 octets long (excluding framing bits, but including FCS octets) and were otherwise well formed.
etherStatsOversizePkts	Indicates the total number of packets received that were longer than 1518 octets (excluding framing bits, but including FCS octets) and were otherwise well formed. Note that for tagged interfaces, this number becomes 1522 bytes.
etherStatsJabbers	Indicates the total number of packets received that were longer than 1518 octets (excluding framing bits, but including FCS octets), and had either a bad FCS with an integral number of octets (FCS error) or a bad FCS with a nonintegral number of octets (alignment error).
etherStatsCollissions	Indicates the number of transmit packets that are collisions; the port and the attached device transmitting at the same time caused collisions.
etherStatsDropEvents	Indicates the number of received frames dropped at the port level.
rx PauseFrames	Indicates the number of received Ethernet IEEE 802.3z pause frames.
mediaIndStatsOversize Dropped	Indicates the number of received oversized packages that are dropped.
mediaIndStatsTxFramesToo Long	Indicates the number of received frames that are too long. The maximum is the programmed maximum frame size (for virtual storage access network [VSAN] support); if the maximum frame size is set to default, then the maximum is the 2112 byte payload plus the 36 byte header, which is a total of 2148 bytes.

15.6.3.2 ML-Series POS Ports Parameters

The POS Ports window lists PM parameter values for each POS port on the card. The parameters displayed depend on the framing mode employed by the ML-Series card. The two framing modes for the POS port on the ML-Series card are HDLC and frame-mapped generic framing procedure (GFP-F). For more information on provisioning a framing mode, refer to the *Cisco ONS 15454 SDH Procedure Guide*.

Auto-Refresh sets a time interval at which automatic refresh will occur. The PM values are a snapshot captured at the time intervals selected in the Auto-Refresh field. Historical PM values are not stored or displayed.

Table 15-12 defines the ML-Series Ethernet card POS Ports parameters for HDLC mode.

Table 15-12 ML-Series POS Ports Parameters for HDLC Mode

Parameter	Meaning
ifInOctets	Indicates the number of bytes received since the last counter reset.
rxTotalPkts	Indicates the number of packets received.
ifOutOctets	Indicates the number of bytes transmitted since the last counter reset.
tx TotalPkts	Indicates the number of transmitted packets.
etherStatsDropEvents	Indicates the number of received frames dropped at the port level.
rxPktsDropped Internal Congestion	Indicates the number of received packets dropped due to overflow in frame buffer.
mediaIndStatsRxFrames Truncated	Indicates the number of received frames with length of 36 bytes or less.
ifInOctets	Indicates the number of bytes received since the last counter reset.
mediaIndStatsRxFramesToo Long	Indicates the number of received frames that are too long. The maximum is the programmed maximum frame size (for VSAN support); if the maximum frame size is set to default, then the maximum is the 2112 byte payload plus the 36 byte header, which is a total of 2148 bytes.
mediaIndStatsRxFramesBad CRC	Indicates the number of received frames with CRC error.
mediaIndStatsRxShortPkts	Indicates the number of received packets that are too small.
hdlcInOctets	Indicates the number of bytes received (from the SONET/SDH path) prior to the bytes undergoing HLDC decapsulation by the policy engine.
hdlcRxAborts	Indicates the number of received packets aborted on input.
hdlcOutOctets	Indicates the number of bytes transmitted (to the SONET/SDH path) after the bytes undergoing HLDC encapsulation by the policy engine.

Table 15-13 defines the ML-Series Ethernet card POS Ports parameters for GFP-F mode.

Table 15-13 ML-Series POS Ports Parameters for GFP-F Mode

Parameter	Meaning
etherStatsDropEvents	Indicates the number of received frames dropped at the port level.
rx PktsDroppedInternal Congestion	Indicates the number of received packets dropped due to overflow in frame buffer.
gfpStatsRxFrame	Indicates the number of received GFP frames.
gfpStatsTxFrame	Indicates the umber of transmitted GFP frames.
gfpStatsRxOctets	Indicates the number of GFP bytes received.
gfpStatsTxOctets	Indicates the number of GFP bytes transmitted.
gfpStatsRxSBitErrors	Indicates the sum of all single bit errors. These are correctable in the GFP CORE HDR at the GFP-T receiver.
gfpStatsRxMBitErrors	Indicates the sum of all the multiple bit errors. These are uncorrectable in the GFP CORE HDR at the GFP-T receiver.

Table 15-13 ML-Series POS Ports Parameters for GFP-F Mode (continued)

Parameter	Meaning
gfpStatsRxTypeInvalid	Indicates the number of receive packets dropped due to Client Data Frame user payload identifier (UPI) error.
gfpStatsRxCRCErrors	Indicates the number of packets received with a payload FCS error.
gfpStatsLFDRaised	Indicates the count of core HEC CRC multiple bit errors. **Note** This count is only of eHec multiple bit errors when in frame. This can be looked at as a count of when the state machine goes out of frame.
gfpStatsCSFRaised	Indicates the number of GFP client signal fail frames detected at the GFP-T receiver.
mediaIndStatsRxFrames Truncated	Indicates the number of received frames that are too long. The maximum is the programmed maximum frame size (for VSAN support). If the maximum frame size is set to default, then the size is the 2112 byte payload plus the 36 byte header, which is a total of 2148 bytes.
mediaIndStatsRxFramesToo Long	Indicates the number of received frames with a CRC error.
mediaIndStatsRxShortPkts	Indicates the number of received packets that are too small.

15.6.4 CE-Series Ethernet Card Performance Monitoring Parameters

CTC provides Ethernet performance information for line-level parameters and historical Ethernet statistics. The CE-Series Ethernet performance information is divided into the Ether Ports and POS Ports tabbed windows within the card view Performance tab window. The following sections describe PM parameters provided for the CE-100T-8 and CE1000-4 Ethernet cards.

15.6.4.1 CE-Series Ether Ports Statistics Parameters

The Ethernet Ether Ports Statistics window lists Ethernet parameters at the line level. The Statistics window provides buttons to change the statistical values shown. The Baseline button resets the displayed statistics values to zero. The Refresh button manually refreshes statistics. Auto-Refresh sets a time interval at which automatic refresh occurs. The CE-Series Statistics window also has a Clear button. The Clear button sets the values on the card to zero, but does not reset the CE-Series card.

During each automatic cycle, whether auto-refreshed or manually refreshed (using the Refresh button), statistics are added cumulatively and are not immediately adjusted to equal total received packets until testing ends. To see the final PM count totals, allow a few moments for the PM window statistics to finish testing and update fully. PM counts are also listed in the CE-Series card Performance > History window.

Table 15-14 defines the CE-Series Ethernet card Ether Ports PM parameters.

Table 15-14 CE-Series Ether Ports PM Parameters

Parameter	Meaning
Time Last Cleared	Specifies a time stamp indicating the last time statistics were reset.
Link Status	Indicates whether the Ethernet link is receiving a valid Ethernet signal (carrier) from the attached Ethernet device. Up denotes present, and Down denotes not present.
ifInOctets	Indicates the number of bytes received since the last counter reset.
rxTotalPkts	Indicates the number of received packets.
ifInUcastPkts	Indicates the number of unicast packets received since the last counter reset.
ifInMulticastPkts	Indicates the number of multicast packets received since the last counter reset.
ifInBroadcastPkts	Indicates the number of broadcast packets received since the last counter reset.
ifInDiscards	Indicates the number of inbound packets that were chosen to be discarded, although no errors had been detected. This is to prevent them moving to a higher-layer protocol. A possible reason for discarding such packets is to free up buffer space.
ifInErrors	Indicates the number of inbound packets (or transmission units) that contain errors that prevent them from being delivered to a higher-layer protocol.
ifOutOctets	Indicates the number of bytes transmitted since the last counter reset.
txTotalPkts	Indicates the number of transmitted packets.
ifOutDiscards[1]	Indicates the number of outbound packets which were chosen to discard even though no errors were detected to prevent the transmission. A possible reason for discarding such a packet could be to free up buffer space.
ifOutErrors[1]	Indicates the number of outbound packets (or transmission units) that could not be transmitted because of errors.
ifOutUcastPkts[2]	Indicates the number of unicast packets transmitted.
ifOutMulticastPkts[2]	Indicates the number of multicast packets transmitted.
ifOutBroadcastPkts[2]	Indicates the number of broadcast packets transmitted.
dot3StatsAlignmentErrors[2]	Indicates the count of frames received on a particular interface that are not an integral number of octets in length and do not pass the FCS check.
dot3StatsFCSErrors	Indicates the count of frames received on a particular interface that are an integral number of octets in length but do not pass the FCS check.
dot3StatsSingleCollisionFrames[2]	Indicates the count of successfully transmitted frames on a particular interface for which transmission is inhibited by exactly one collision.

Table 15-14 CE-Series Ether Ports PM Parameters (continued)

Parameter	Meaning
dot3StatsFrameTooLong	Indicates the count of frames received on a particular interface that exceed the maximum permitted frame size.
etherStatsUndersizePkts	Indicates the total number of packets received that were less than 64 octets long (excluding framing bits, but including FCS octets) and were otherwise well formed.
etherStatsUndersizePkts	Indicates the total number of packets received that were less than 64 octets long (excluding framing bits, but including FCS octets) and were otherwise well formed.
etherStatsFragments	Indicates the total number of packets received that were less than 64 octets in length (excluding framing bits but including FCS octets) and had either a bad FCS with an integral number of octets (FCS error) or a bad FCS with a nonintegral number of octets (alignment error). **Note** It is entirely normal for etherStatsFragments to increment. This is because it counts both runts (which are normal occurrences due to collisions) and noise hits.
etherStatsPkts64Octets	Indicates the total number of packets (including bad packets) received that were 64 octets in length (excluding framing bits but including FCS octets).
etherStatsPkts65to127Octets	Indicates the total number of packets (including bad packets) received that were between 65 and 127 octets in length inclusive (excluding framing bits but including FCS octets).
etherStatsPkts128to255Octets	Indicates the total number of packets (including bad packets) received that were between 128 and 255 octets in length inclusive (excluding framing bits but including FCS octets).
etherStatsPkts256to511Octets	Indicates the total number of packets (including bad packets) received that were between 256 and 511 octets in length inclusive (excluding framing bits but including FCS octets).
etherStatsPkts512to1023Octets	Indicates the total number of packets (including bad packets) received that were between 512 and 1023 octets in length inclusive (excluding framing bits but including FCS octets).
etherStatsPkts1024to1518 Octets	Indicates the total number of packets (including bad packets) received that were between 1024 and 1518 octets in length inclusive (excluding framing bits but including FCS octets).
etherStatsBroadcastPkts	Indicates the total number of good packets received that were directed to the broadcast address. Note that this does not include multicast packets.
etherStatsMulticastPkts	Indicates the total number of good packets received that were directed to a multicast address. Note that this number does not include packets directed to the broadcast address.
etherStatsOversizePkts	Indicates the total number of packets received that were longer than 1518 octets (excluding framing bits, but including FCS octets) and were otherwise well formed. Note that for tagged interfaces, this number becomes 1522 bytes.

Table 15-14 CE-Series Ether Ports PM Parameters (continued)

Parameter	Meaning
etherStatsJabbers	Indicates the total number of packets received that were longer than 1518 octets (excluding framing bits, but including FCS octets), and had either a bad FCS with an integral number of octets (FCS error) or a bad FCS with a nonintegral number of octets (alignment error).
etherStatsOctets	Indicates the total number of octets of data (including those in bad packets) received on the network (excluding framing bits but including FCS octets.
rxPauseFrames[1]	Number of received pause frames.
txPauseFrames[1]	Number of transmitted pause frames.
rxPktsDroppedInternalCongestion[1]	Indicates the number of received packets dropped due to overflow in frame buffer.
txPktsDroppedInternalCongestion[1]	Indicates the number of transmit queue drops due to drops in frame buffer.
rxControlFrames[1]	Indicates the number of control frames received.
mediaIndStatsRxFramesTruncated[1]	Indicates the number of received frames with a length of 36 bytes or less.
mediaIndStatsRxFramesTooLong[1]	Indicates the number of received frames that are too long. The maximum is the programmed maximum frame size (for VSAN support); if the maximum frame size is set to default, then the maximum is the 2112 byte payload plus the 36 byte header, which is a total of 2148 bytes.
mediaIndStatsRxFramesBadCRC[1]	Indicates the number of received frames with CRC errors.
mediaIndStatsTxFramesBadCRC[1]	Indicates the number of transmitted frames with CRC error.
mediaIndStatsRxShortPkts[1]	Indicates the number of received packets that are too small.
etherStatsCollisions[2]	Indicates the number of transmit packets that are collisions. The port and the attached device transmitting at the same time might cause collisions.
etherStatsCRCAlignErrors[2]	Indicates the total number of packets received that had a length (excluding framing bits, but including FCS octets) of between 64 and 1518 octets, inclusive, but had either a bad FCS with an integral number of octets (FCS error) or a bad FCS with a nonintegral number of octets (alignment error).
etherStatsDropEvents[2]	Indicates the number of received frames dropped at the port level.

1. For CE1000-4 only
2. For CE100T-8 only

15.6.4.2 CE-Series Card Ether Ports Utilization Parameters

The Ether Ports Utilization window shows the percentage of Tx and Rx line bandwidth used by the Ethernet ports during consecutive time segments. The Utilization window provides an Interval menu that enables you to set time intervals of 1 minute, 15 minutes, 1 hour, and 1 day. Line utilization is calculated with the following formulas:

Rx = (inOctets + inPkts * 20) * 8 / 100% interval * maxBaseRate

Tx = (outOctets + outPkts * 20) * 8 / 100% interval * maxBaseRate

The interval is defined in seconds. The maxBaseRate is defined by raw bits per second in one direction for the Ethernet port (that is, 1 Gbps). The maxBaseRate for CE-Series Ethernet cards is shown in Table 15-8 on page 15-20.

15.6.4.3 CE-Series Card Ether Ports History Parameters

The Ethernet Ether Ports History window lists past Ethernet statistics for the previous time intervals. Depending on the selected time interval, the History window displays the statistics for each port for the number of previous time intervals as shown in Table 15-9 on page 15-21. The parameters are those defined in Table 15-14 on page 15-27.

15.6.4.4 CE-Series POS Ports Statistics Parameters

The Ethernet POS Ports statistics window lists Ethernet POS parameters at the line level. Table 15-15 defines the CE-Series Ethernet card POS Ports parameters.

Table 15-15 CE-Series POS Ports Statistics Parameters

Parameter	Definition
Time Last Cleared	A time stamp indicating the last time that statistics were reset.
Link Status	Indicates whether the Ethernet link is receiving a valid Ethernet signal (carrier) from the attached Ethernet device; up means present, and down means not present.
ifInOctets	Number of bytes received since the last counter reset.
rxTotalPkts	Number of received packets.
ifInDiscards[1]	The number of inbound packets that were chosen to be discarded even though no errors had been detected to prevent their being deliverable to a higher-layer protocol. One possible reason for discarding such a packet could be to free buffer space.
ifInErrors[1]	The number of inbound packets (or transmission units) that contained errors preventing them from being deliverable to a higher-layer protocol.
ifOutOctets	Number of bytes transmitted since the last counter reset.
txTotalPkts	Number of transmitted packets.
ifOutOversizePkts[1]	Packets greater than 1518 bytes transmitted out a port.
gfpStatsRxFrame[2]	Number of received GFP frames.
gfpStatsTxFrame[2]	Number of transmitted GFP frames.
gfpStatsRxCRCErrors	Number of packets received with a payload FCS error.
gfpStatsRxOctets[2]	Number of GFP bytes received.

Table 15-15 CE-Series POS Ports Statistics Parameters

Parameter	Definition
gfpStatsTxOctets[2]	Number of GFP bytes transmitted.
gfpStatsRxSBitErrors	Sum of all the single bit errors. In the GFP CORE HDR at the GFP-T receiver, these are correctable.
gfpStatsRxMBitErrors	Sum of all the multiple bit errors. In the GFP CORE HDR at the GFP-T receiver, these are uncorrectable.
gfpStatsRxTypeInvalid	Number of receive packets dropped due to Client Data Frame UPI errors.
gfpStatsRxCIDInvalid[1]	Number of packets with invalid CID.
gfpStatsCSFRaised	Number of GFP Client signal fail frames detected at the GFP-T receiver.
ifInPayloadCrcErrors[1]	Received payload CRC errors.
ifOutPayloadCrcErrors[1]	Transmitted payload CRC errors.
hdlcPktDrops	Number of received packets dropped before input.

1. Applicable only for CE100T-8
2. Applicable only for CE1000-4

15.6.4.5 CE-Series Card POS Ports Utilization Parameters

The POS Ports Utilization window shows the percentage of Tx and Rx line bandwidth used by the POS ports during consecutive time segments. The Utilization window provides an Interval menu that enables you to set time intervals of 1 minute, 15 minutes, 1 hour, and 1 day. Line utilization is calculated with the following formulas:

Rx = (inOctets * 8) / (interval * maxBaseRate)

Tx = (outOctets * 8) / (interval * maxBaseRate)

The interval is defined in seconds. The maxBaseRate is defined by raw bits per second in one direction for the Ethernet port (that is, 1 Gbps). The maxBaseRate for CE-Series cards is shown in Table 15-8 on page 15-20.

Note Line utilization numbers express the average of ingress and egress traffic as a percentage of capacity.

15.6.4.6 CE-Series Card Ether Ports History Parameters

The Ethernet POS Ports History window lists past Ethernet POS Ports statistics for the previous time intervals. Depending on the selected time interval, the History window displays the statistics for each port for the number of previous time intervals as shown in Table 15-15 on page 15-30. The parameters are defined in Table 15-9 on page 15-21.

15.7 Performance Monitoring for Optical Cards

The following sections define performance monitoring parameters and definitions for the OC3 IR 4/STM1 SH 1310 card, the OC3 IR/STM1 SH 1310-8 card, the OC12 IR/STM4 SH 1310, OC12 LR/STM4 LH 1310 card, the OC12 LR/STM4 LH 1550 card, the OC12 IR/STM4 SH 1310-4 card, the OC48 IR/STM16 SH AS 1310 card, OC48 LR/STM16 LH AS 1550 card, the OC48 ELR/STM16 EH

100 GHz card, the OC192 SR/STM64 IO 1310 card, the OC192 IR/STM64 SH 1550 card, OC192 LR/STM 64 LH 1550 card, the OC192 LR/STM64 LH ITU 15xx.xx, OC192 SR1/STM64IO Short Reach card, and the OC192/STM64 Any Reach card.

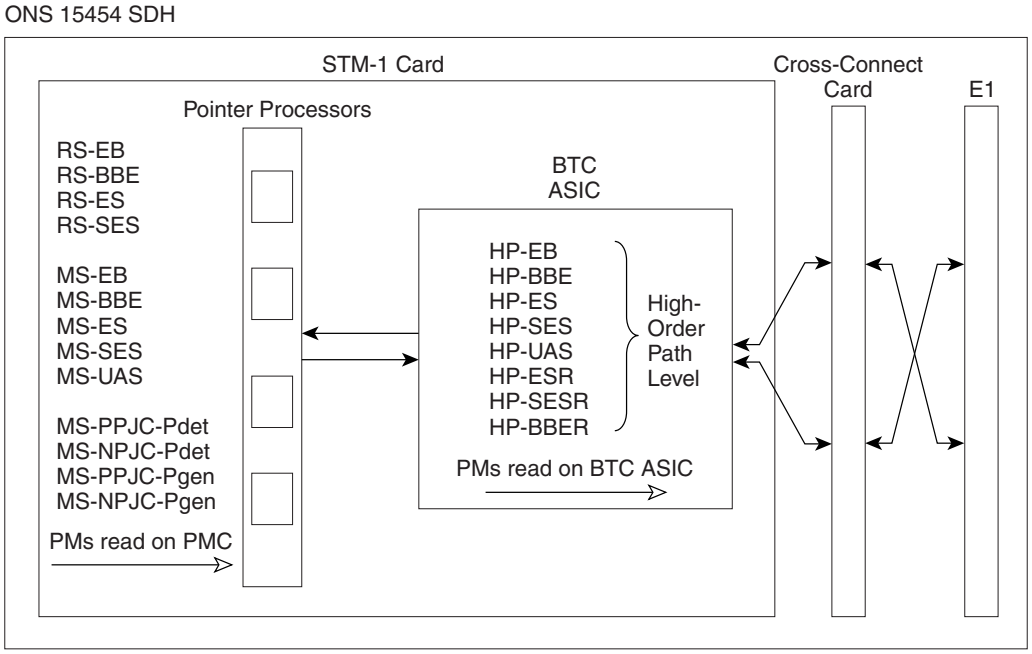
On all STM-N optical cards, errors are calculated in bits instead of blocks for B1 and B3. This means there could possibly be a slight difference between what is inserted and what is reported on CTC. In STM4, for example, there are approximately 15,000 to 30,000 bits per block (per ITU-T-G.826). If there were two bit errors within that block, the standard would require reporting one block error whereas the STM-N cards would have reported two bit errors.

When a tester inputs only single errors during testing, this issue would not appear because a tester is not fast enough to induce two errors within a single block. However, if the test is performed with an error rate, certain error rates could cause two or more errors in a block. For example, since the STM4 is roughly 622 Mbps and the block in the STM4 has 15,000 bits, there would be about 41,467 blocks in a second. If the tester inputs a $10e^{-4}$ error rate, that would create 62,200 errors per second. If the errors are distributed uniformly, then CTC could potentially report two bit errors within a single block. On the other hand, if the error ratio is $10e^{-5}$, then there will be 6,220 errors per second. If the errors are not distributed uniformly, then CTC might report one bit error within a single block. In summary, if the errors are distributed equally, then a discrepancy with the standard might be seen when a tester inputs $10e^{-4}$ or $10e^{-3}$ error rates.

15.7.1 STM-1 Card Performance Monitoring Parameters

Figure 15-8 shows where overhead bytes detected on the ASICs produce performance monitoring parameters for the OC3 IR 4/STM1 SH 1310 card and the OC3 IR/STM1 SH 1310-8 card.

Figure 15-8 PM Read Points on the STM-1 Cards



The PM parameters for the STM-1 and STM1 SH 1310-8 cards are listed in Table 15-16. The parameters are defined in Table 15-3 on page 15-5.

Table 15-16 PM Parameters for the STM-1 and STM1 SH 1310-8 Cards

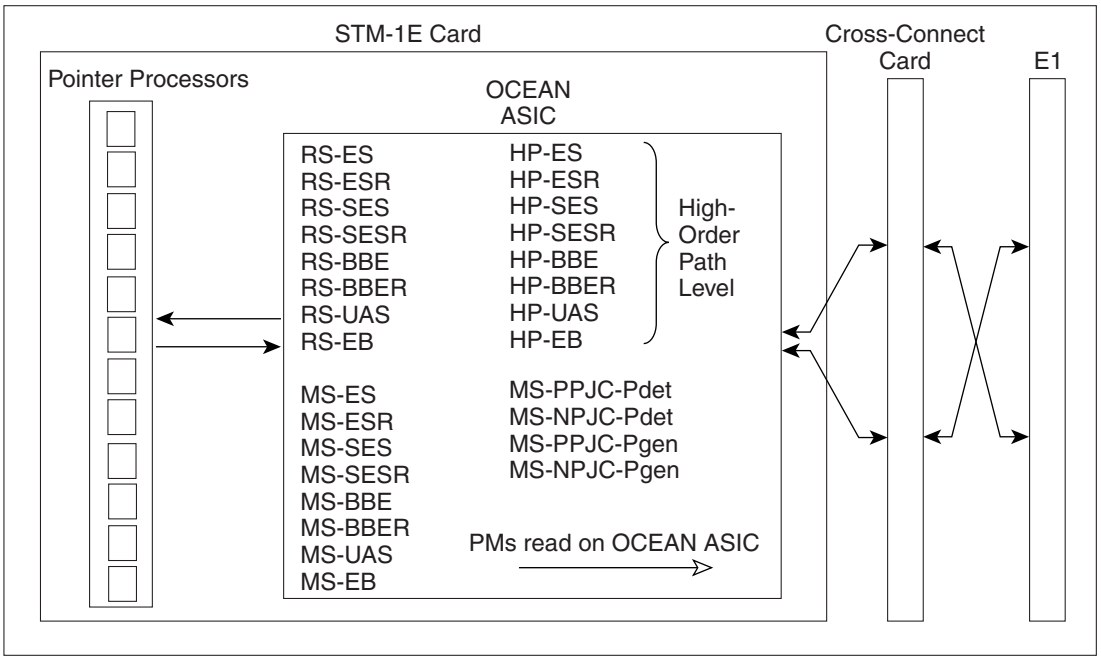
RS (NE)	MS (NE/FE)	1+1 LMSP (NE)[1, 2]	PJC (NE)[3]	VC4 and VC4-*Xc* HP Path (NE/FE[4])[5]
RS-BBE	MS-BBE	MS-PSC (1+1)	HP-PPJC-Pdet	HP-BBE
RS-EB	MS-EB	MS-PSD	HP-NPJC-Pdet	HP-BBER
RS-ES	MS-ES		HP-PPJC-Pgen	HP-EB
RS-SES	MS-SES		HP-NPJC-Pgen	HP-ES
	MS-UAS		HP-PJCS-Pdet	HP-ESR
			HP-PJCS-Pgen	HP-SES
			HP-PJCDiff	HP-SESR
				HP-UAS

1. For information about troubleshooting subnetwork connection protection (SNCP) switch counts, refer to the "Alarm Troubleshooting" chapter in the *Cisco ONS 15454 SDH Troubleshooting Guide*. For information about creating circuits that perform a switch, refer to Chapter 11, "Circuits and Tunnels."
2. MS-SPRing is not supported on the STM-1 card and STM-1E card; therefore, the MS-PSD-W, MS-PSD-S, and MS-PSD-R PM parameters do not increment.
3. In CTC, the count fields for the HP-PPJC and HP-NPJC PM parameters appear white and blank unless they are enabled on the Provisioning > Line tab. See the "15.3 Pointer Justification Count Performance Monitoring" section on page 15-4.
4. Far-end high-order VC4 and VC4-*Xc* path PM parameters do not apply to the STM1-4 card.
5. SDH path PM parameters do not increment unless IPPM is enabled. See the "15.2 Intermediate-Path Performance Monitoring" section on page 15-3.

15.7.2 STM-1E Card Performance Monitoring Parameters

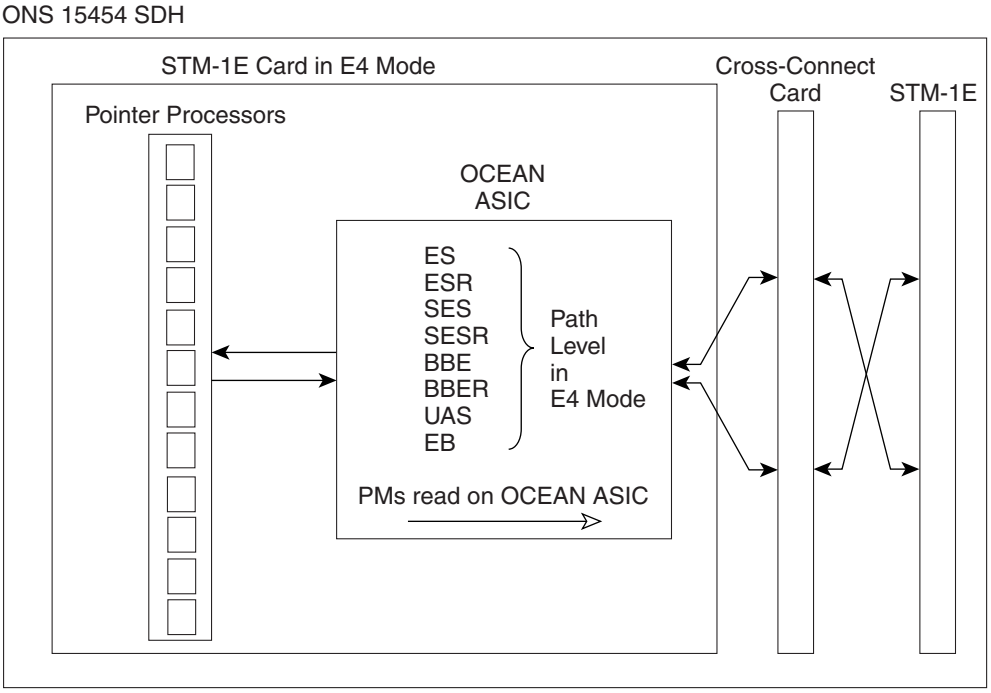
Figure 15-9 shows where overhead bytes detected on the ASICs produce performance monitoring parameters for the STM-1E card.

Figure 15-9 PM Read Points on the STM-1E Cards



Ports 9 to 12 can be provisioned as E4 framed from the Provisioning > Ports tabs. Figure 15-10 shows the VC4 performance monitoring parameters in E4 mode.

Figure 15-10 PM Read Points on the STM-1E Cards in E4 Mode



The PM parameters for the STM-1E cards are listed in Table 15-17. The parameters are defined in Table 15-3 on page 15-5.

Table 15-17 PM Parameters for the STM-1E Cards

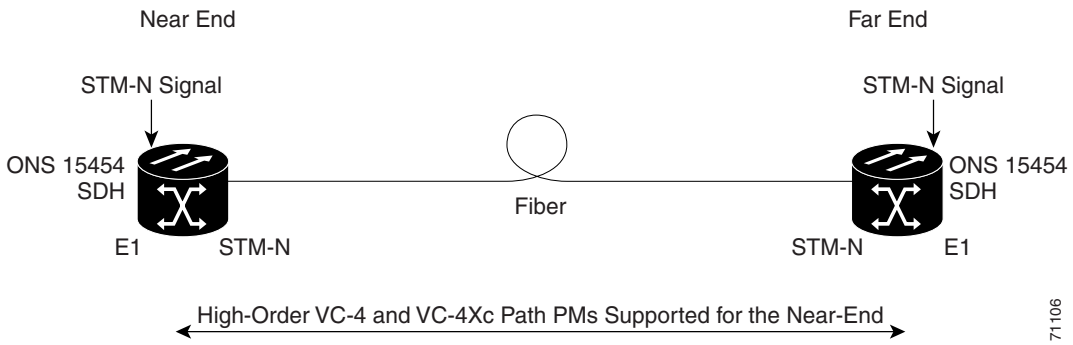
RS (NE)	MS (NE/FE)	PJC (NE)[1, 2]	VC4 and VC4-Xc HP Path (NE)[3]	VC4 and VC4-Xc Path for E4 Mode (NE)
RS-BBE	MS-BBE	HP-PPJC-Pdet	HP-BBER	BBE
RS-BBER	MS-BBER	HP-NPJC-Pdet	HP-BBER	BBER
RS-EB	MS-EB	HP-PPJC-Pgen	HP-EB	EB
RS-ES	MS-ES	HP-NPJC-Pgen	HP-ES	ES
RS-ESR	MS-ESR		HP-ESR	ESR
RS-SES	MS-SES		HP-SES	SES
RS-SESR	MS-SESR		HP-SESR	SESR
UAS-SR			HP-UAS	UAS

1. In CTC, the count fields for PPJC and NPJC PM parameters appear white and blank unless they are enabled on the Provisioning > OC3 Line tabs. See the "15.3 Pointer Justification Count Performance Monitoring" section on page 15-4.
2. For information about troubleshooting SNCP switch counts, refer to the "Alarm Troubleshooting" chapter in the *Cisco ONS 15454 SDH Troubleshooting Guide*.
3. SDH path PM parameters do not increment unless IPPM is enabled. See the "15.2 Intermediate-Path Performance Monitoring" section on page 15-3.

15.7.3 STM-4 Card Performance Monitoring Parameters

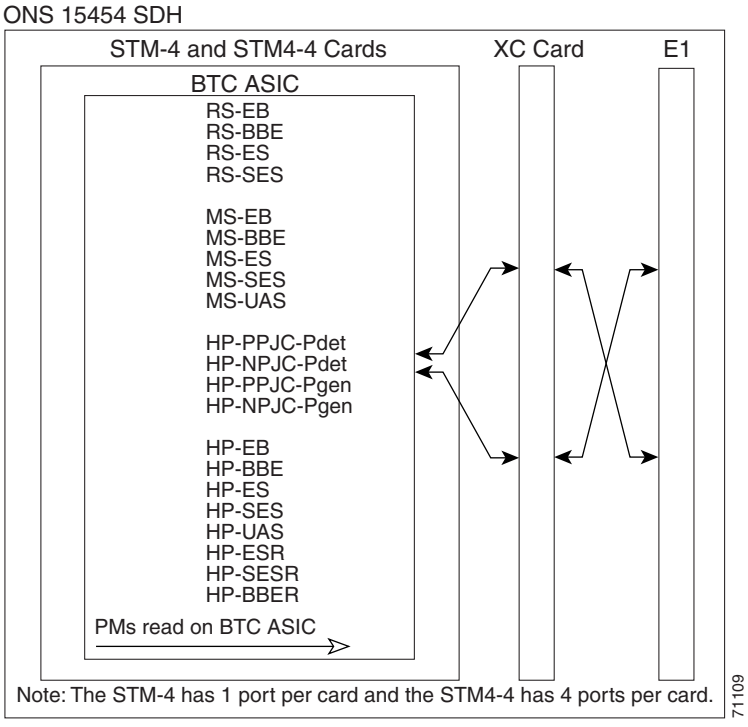
Figure 15-11 shows the signal types that support near-end and far-end PM parameters for the OC12 IR/STM4 SH 1310, OC12 LR/STM4 LH 1310 card, the OC12 LR/STM4 LH 1550 card, and the OC12 IR/STM4 SH 1310-4 card. Figure 15-12 shows where overhead bytes detected on the ASICs produce performance monitoring parameters for the

Figure 15-11 Monitored Signal Types for the STM-4 Cards



Note PM parameters on the protect VC4 are not supported for MS-SPRing.

Figure 15-12 PM Read Points on the STM-4 Cards



The PM parameters for the STM-4 cards are described in Table 15-18. The parameters are defined in Table 15-3 on page 15-5.

Table 15-18 PM Parameters for STM-4 Cards

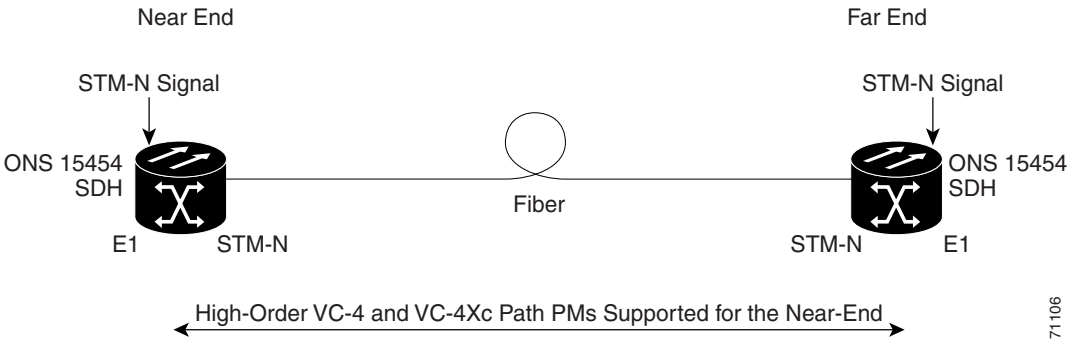
RS (NE/FE)	MS (NE/FE)	PSC (NE)[1]	PJC (NE)[2]	VC4 and VC4-Xc HP Path (NE)[3]
RS-BBE	MS-BBE	MS-PSC (1+1)	HP-PPJC-Pdet	HP-BBE
RS-EB	MS-EB	MS-PSC (MS-SPRing)	HP-NPJC-Pdet	HP-BBER
RS-ES	MS-ES	MS-PSD	HP-PPJC-Pgen	HP-EB
RS-SES	MS-SES	MS-PSC-W	HP-NPJC-Pgen	HP-ES
	MS-UAS	MS-PSD-W		HP-ESR
		MS-PSC-S		HP-SES
		MS-PSD-S		HP-SESR
		MS-PSC-R		HP-UAS
		MS-PSD-R		

1. For information about troubleshooting SNCP switch counts, refer to the "Alarm Troubleshooting" chapter in the *Cisco ONS 15454 SDH Troubleshooting Guide*. For information about creating circuits that perform a switch, see the Chapter 11, "Circuits and Tunnels."
2. In CTC, the count fields for HP-PPJC and HP-NPJC PM parameters appear white and blank unless they are enabled on the Provisioning > Line tab. See the "15.3 Pointer Justification Count Performance Monitoring" section on page 15-4.
3. SDH path PM parameters do not increment unless IPPM is enabled. See the "15.2 Intermediate-Path Performance Monitoring" section on page 15-3.

15.7.4 STM-16 and STM-64 Card Performance Monitoring Parameters

Figure 15-13 shows the signal types that support near-end and far-end PM parameters for the OC48 IR/STM16 SH AS 1310 card, the OC48 LR/STM16 LH AS 1550 card, the OC48 ELR/STM16 EH 100 GHz card, the OC192 SR/STM64 IO 1310 card, the OC192 IR/STM64 SH 1550 card, the OC192 LR/STM 64 LH 1550 card, the OC192 LR/STM64 LH ITU 15xx.xx card, the OC192 SR1/STM64IO Short Reach card, and the OC192/STM64 Any Reach card.

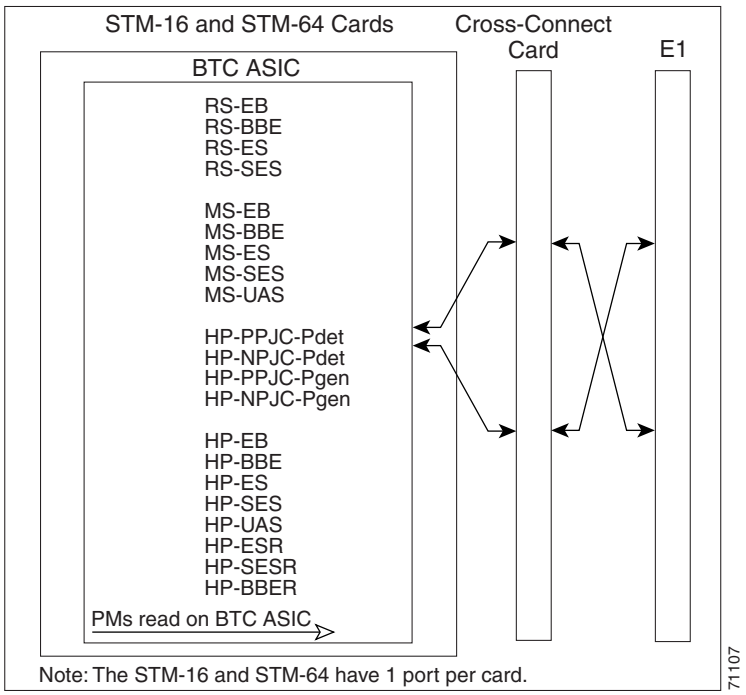
Figure 15-13 Monitored Signal Types for STM-16 and STM-64 Cards



Note PM parameters on the protect VC4 are not supported for MS-SPRing.

Figure 15-14 shows where overhead bytes detected on the ASICs produce performance monitoring parameters for STM-16 and STM-64 cards.

Figure 15-14 PM Read Points on STM-16 and STM-64 Cards



The PM parameters for STM-16 and STM-64 cards are listed Table 15-19.

Table 15-19 PM Parameters for STM-16 and STM-64 Cards

RS (NE/FE)	MS (NE/FE)	PSC (NE)[1]	PJC (NE)[2]	VC4 and VC4-Xc HP Path (NE)[3]
RS-BBE	MS-BBE	MS-PSC (1+1)	HP-PPJC-Pdet	HP-BBE
RS-EB	MS-EB	MS-PSC (MS-SPRing)	HP-NPJC-Pdet	HP-BBER
RS-ES	MS-ES	MS-PSD	HP-PPJC-Pgen	HP-EB
RS-SES	MS-SES	MS-PSC-W	HP-NPJC-Pgen	HP-ES
	MS-UAS	MS-PSD-W	HP-PJCDiff	HP-ESR
		MS-PSC-S	HP-PJCS-Pdet	HP-SES
		MS-PSD-S	HP-PJCS-Pgen	HP-SESR
		MS-PSC-R		HP-UAS
		MS-PSD-R		

1. For information about troubleshooting SNCP switch counts, refer to the "Alarm Troubleshooting" chapter in the *Cisco ONS 15454 SDH Troubleshooting Guide*. For information about creating circuits that perform a switch, see the Chapter 11, "Circuits and Tunnels."
2. In CTC, the count fields for HP-PPJC and HP-NPJC PM parameters appear white and blank unless they are enabled on the Provisioning > Line tab. See the "15.3 Pointer Justification Count Performance Monitoring" section on page 15-4.
3. SDH path PM parameters do not increment unless IPPM is enabled. See the "15.2 Intermediate-Path Performance Monitoring" section on page 15-3.

Note If the MS-EB(NE and FE) falls in a specific range, then, the user might see discrepancy in the MS-SES and the MS-UAS values. However, MS-ES will be in the nearest accuracy. For a few seconds, in a given 10 seconds interval, the number of MS-EB counted may not cross the EB count criteria for MS-SES, (due to system/application limitation for the below mentioned ranges); as a consequence of which there may not be 10 continuous MS-SES, thus MS-UAS will not be observed. The corresponding (error) range for the line rates is as shown in Table 15-20.

Table 15-20 Table of Border Error Rates

Line Rate	Error Ranges
STM1	28800-28810
STM4	192000-192010
STM16	921600-921610
STM64	3686400-3686410

15.7.5 MRC-12 Card Performance Monitoring Parameters

This section lists performance monitoring parameters for the mutirate card, also known as the MRC-12. card.

Figure 15-15 shows where overhead bytes detected on the ASICs produce performance monitoring parameters for the MRC-12 card.

Figure 15-15 PM Read Points for the MRC-12 Card

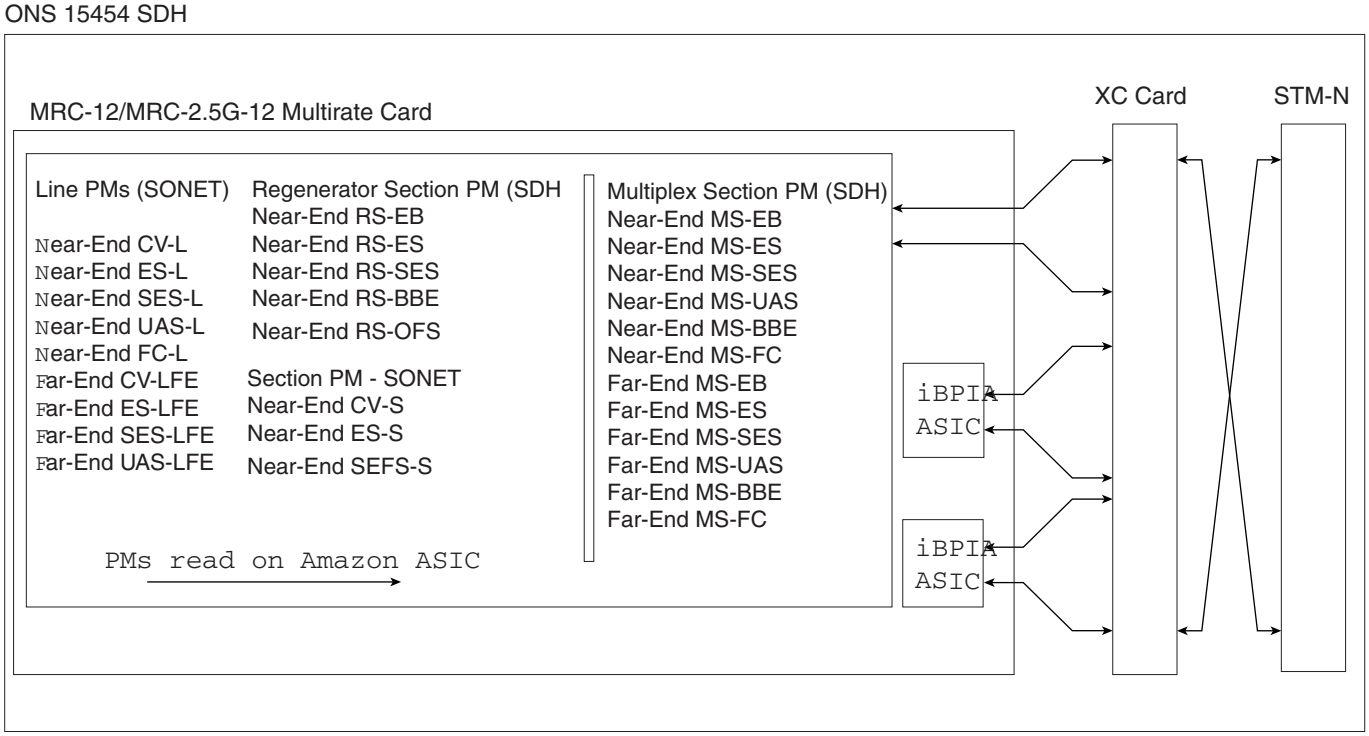


Table 15-21 lists the PM parameters for MRC-12 cards.

Table 15-21 MRC-12 Card PMs

Regenerator Section (NE)	Multiplex Section (NE)	Multiplex Section (FE)
RS-EB	MS-EB	MS-EB
RS-ES	MS-ES	MS-ES
RS-SES	MS-SES	MS-SES
RS-BBE	MS-UAS	MS-UAS
RS-OFS	MS-BBE	MS-BBE
	MS-FC	MS-FC

15.8 Performance Monitoring for the Fiber Channel Card

The following sections define PM parameters and definitions for the FC_MR-4 card.

15.8.1 FC_MR-4 Card Performance Monitoring Parameters

CTC provides FC_MR-4 performance information, including line-level parameters, port bandwidth consumption, and historical statistics. The FC_MR-4 card performance information is divided into the Statistics, Utilization, and History tabbed windows within the card view Performance tab window.

15.8.1.1 FC_MR-4 Statistics Window

The Statistics window lists parameters at the line level. The Statistics window provides buttons to change the statistical values shown. The Baseline button resets the displayed statistics values to zero. The Refresh button manually refreshes statistics. Auto-Refresh sets a time interval at which automatic refresh occurs. The Statistics window also has a Clear button. The Clear button sets the values on the card to zero. All counters on the card are cleared.

Table 15-22 defines the FC_MR-4 card statistics parameters.

Parameter	Definition
Time Last Cleared	Time stamp indicating the time at which the statistics were last reset.
Link Status	Indicates whether the Fibre Channel link is receiving a valid Fibre Channel signal (carrier) from the attached Fibre Channel device; up means present, and down means not present.
ifInOctets	Number of bytes received without error for the Fibre Channel payload.
rxTotalPkts	Number of Fibre Channel frames received without errors.
ifInDiscards	Number of inbound packets that were chosen to be discarded even though no errors had been detected to prevent their being deliverable to a higher-layer protocol. One possible reason for discarding such a packet could be to free up buffer space.
ifInErrors	Sum of frames that are oversized, undersized, or with cyclic redundancy check (CRC) error.
ifOutOctets	Number of bytes transmitted without error for the Fibre Channel payload.
txTotalPkts	Number of Fibre Channel frames transmitted without errors.
ifOutDiscards	Number of outbound packets which were chosen to be discarded even though no errors had been detected to prevent their transmission. A possible reason for discarding such packets could be to free up buffer space.
gfpStatsRxSBitErrors	Number of single bit errors in core header error check (CHEC).
gfpStatsRxMBitErrors	Number of multiple bit errors in CHEC.
gfpStatsRxTypeInvalid	Number of invalid generic framing procedure (GFP) type field received. This includes unexpected user payload identifier (UPI) type and also errors in CHEC.
gfpStatsRxSblkCRCErrors	Number of super block CRC errors.
gfpStatsRoundTripLatencyUSec	Round trip delay for the end-to-end Fibre Channel transport in milli seconds.
gfpStatsRxDistanceExtBuffers	Number of buffer credit received for GFP-T receiver (valid only if distance extension is enabled).
gfpStatsTxDistanceExtBuffers	Number of buffer credit transmitted for GFP-T transmitter (valid only if distance extension is enabled).
mediaIndStatsRxFramesTruncated	Number of Fibre Channel frames received with frame size <= 36 bytes.

Parameter	Definition
mediaIndStatsRxFramesTooLong	Number of Fibre Channel frames received with frame size higher than the provisioned maximum frame size.
mediaIndStatsRxFramesBadCRC	Number of Fibre Channel frames received with bad CRC.
mediaIndStatsTxFramesBadCRC	Number of Fibre Channel frames transmitted with bad CRC.
fcStatsLinkRecoveries	Number of link recoveries.
fcStatsRxCredits	Number of buffers received to buffer credits T (valid only if distance extension is enable).
fcStatsTxCredits	Number of buffers transmitted to buffer credits T (valid only if distance extension is enable).
fcStatsZeroTxCredits	Number of transmit attempts that failed because of unavailable credits.
8b10bInvalidOrderedSets	8b10b loss of sync count on Fibre Channel line side.
8b10bStatsEncodingDispErrors	8b10b disparity violations count on Fibre Channel line side.
gfpStatsCSFRaised	Number of GFP Client Signal Fail frames detected.

15.8.1.2 FC_MR-4 Utilization Window

The Utilization window shows the percentage of Tx and Rx line bandwidth used by the ports during consecutive time segments. The Utilization window provides an Interval menu that enables you to set time intervals of 1 minute, 15 minutes, 1 hour, and 1 day. Line utilization is calculated with the following formulas:

Rx = (inOctets + inPkts * 24) * 8 / 100% interval * maxBaseRate

Tx = (outOctets + outPkts * 24) * 8 / 100% interval * maxBaseRate

The interval is defined in seconds. The maxBaseRate is defined by raw bits per second in one direction for the port (that is, 1 Gbps or 2 Gbps). The maxBaseRate for FC_MR-4 cards is shown in Table 15-22.

Table 15-22 maxBaseRate for STS Circuits

STS	maxBaseRate
STS-24	850000000
STS-48	850000000 x 2[1]

1. For 1 Gigabit of bit rate being transported, there is only 850 Mbps of actual data because of 8b->10b conversion. Similarly, for 2 G of bit rate being transported there is only 850 Mbps x 2 of actual data.

Note Line utilization numbers express the average of ingress and egress traffic as a percentage of capacity.

15.8.1.3 FC_MR-4 History Window

The History window lists past FC_MR-4 statistics for the previous time intervals. Depending on the selected time interval, the History window displays the statistics for each port for the number of previous time intervals as shown in Table 15-23. The parameters are defined in Table 15-9 on page 15-21.

Table 15-23 FC_MR-4 History Statistics per Time Interval

Time Interval	Number of Intervals Displayed
1 minute	60 previous time intervals
15 minutes	32 previous time intervals
1 hour	24 previous time intervals
1 day (24 hours)	7 previous time intervals

CHAPTER 16

SNMP

This chapter explains Simple Network Management Protocol (SNMP) as implemented by the Cisco ONS 15454 SDH.

For SNMP setup information, refer to the *Cisco ONS 15454 SDH Procedure Guide*.

Chapter topics include:

- 16.1 SNMP Overview, page 16-1
- 16.2 Basic SNMP Components, page 16-2
- 16.3 SNMP External Interface Requirement, page 16-4
- 16.4 SNMP Version Support, page 16-4
- 16.5 SNMP Message Types, page 16-4
- 16.6 SNMP Management Information Bases, page 16-5
- 16.7 SNMP Trap Content, page 16-8
- 16.8 SNMP Community Names, page 16-16
- 16.9 Proxy Over Firewalls, page 16-16
- 16.10 Remote Monitoring, page 16-16

16.1 SNMP Overview

SNMP is an application-layer communication protocol that allows ONS 15454 SDH network devices to exchange management information among these systems and with other devices outside the network. Through SNMP, network administrators can manage network performance, find and solve network problems, and plan network growth. Up to 10 SNMP trap destinations and five concurrent CTC user sessions are allowed per node.

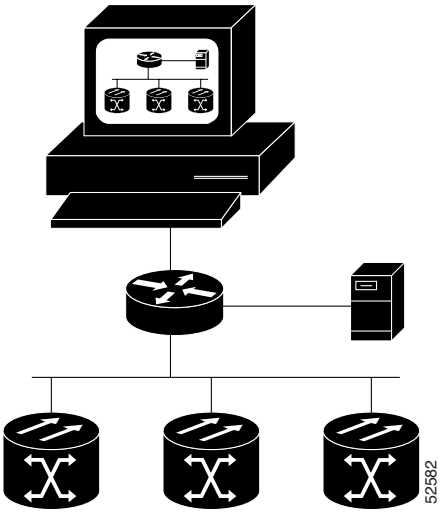
The ONS 15454 SDH uses SNMP for asynchronous event notification to a network management system (NMS). ONS SNMP implementation uses standard Internet Engineering Task Force (IETF) management information bases (MIBs) to convey node-level inventory, fault, and performance management information for generic read-only management of electrical, SDH, and Ethernet technologies. SNMP allows a generic SNMP manager such as HP OpenView Network Node Manager (NNM) or Open Systems Interconnection (OSI) NetExpert to be utilized for limited management functions.

The Cisco ONS 15454 SDH supports SNMP Version 1 (SNMPv1) and SNMP Version 2c (SNMPv2c). Both of these versions share many features, but SNMPv2c includes additional protocol operations and 64-bit performance monitoring support. This chapter describes both versions and gives SNMP configuration parameters for the ONS 15454 SDH.

Note The CERENT-MSDWDM-MIB.mib, CERENT-FC-MIB.mib, and CERENT-GENERIC-PM-MIB.mib in the CiscoV2 directory support 64-bit performance monitoring counters. The SNMPv1 MIB in the CiscoV1 directory does not contain 64-bit performance monitoring counters, but supports the lower and higher word values of the corresponding 64-bit counter. The other MIB files in the CiscoV1 and CiscoV2 directories are identical in content and differ only in format.

Figure 16-1 illustrates the basic layout idea of an SNMP-managed network.

Figure 16-1 Basic Network Managed by SNMP

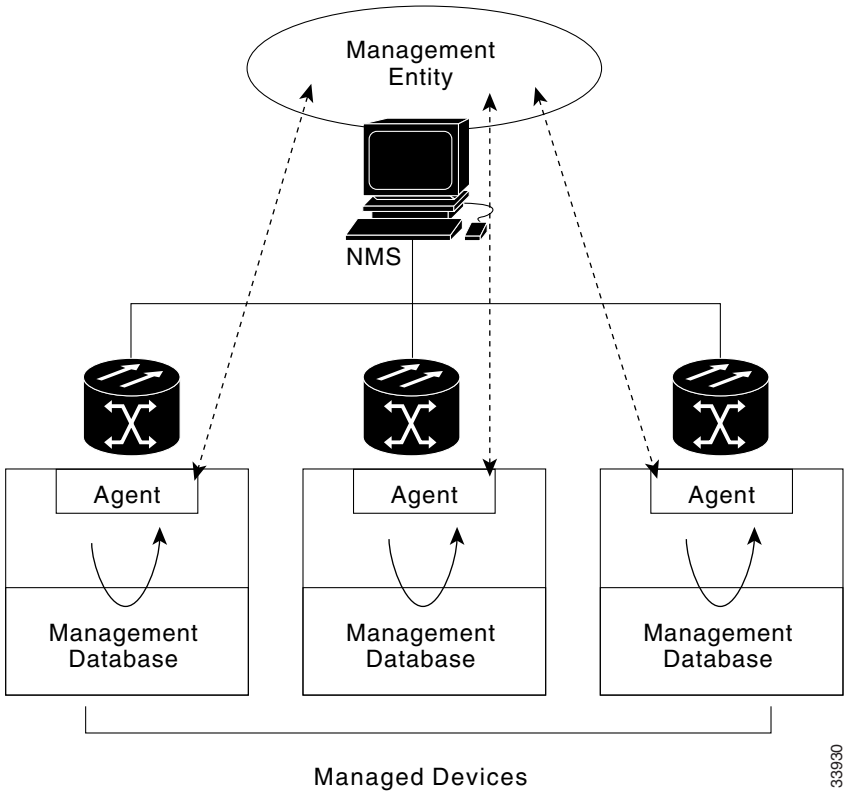


16.2 Basic SNMP Components

In general terms, an SNMP-managed network consists of a management system, agents, and managed devices.

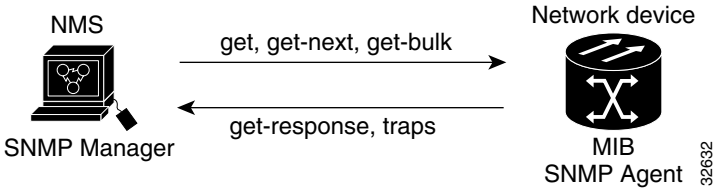
A management system such as HP OpenView executes monitoring applications and controls managed devices. Management systems execute most of the management processes and provide the bulk of memory resources used for network management. A network might be managed by one or more management systems. Figure 16-2 illustrates the relationship between the network manager, SNMP agent, and the managed devices.

Figure 16-2 Example of the Primary SNMP Components



An agent (such as SNMP) residing on each managed device translates local management information data, such as performance information or event and error information caught in software traps, into a readable form for the management system. Figure 16-3 illustrates SNMP agent get-requests that transport data to the network management software.

Figure 16-3 Agent Gathering Data from a MIB and Sending Traps to the Manager



The SNMP agent captures data from management information bases, or MIBs, which are device parameter and network data repositories, or from error or change traps.

A managed element—such as a router, access server, switch, bridge, hub, computer host, or network element (such as an ONS 15454 SDH)—is accessed through the SNMP agent. Managed devices collect and store management information, making it available via SNMP to other management systems having the same protocol compatibility.

16.3 SNMP External Interface Requirement

Since all SNMP requests come from a third-party application, the only external interface requirement is that a third-party SNMP client application can upload RFC 3273 SNMP MIB variables in the etherStatsHighCapacityTable, etherHistoryHighCapacityTable, or mediaIndependentTable.

16.4 SNMP Version Support

The ONS 15454 SDH supports SNMPv1 and SNMPv2c traps and get requests. SNMP MIBs define alarms, traps, and status. Through SNMP, NMS applications can query a management agent for data from functional entities such as Ethernet switches and SDH multiplexers using a supported MIB.

Note ONS 15454 SDH MIB files in the CiscoV1 and CiscoV2 directories are almost identical in content except for the difference in 64-bit performance monitoring features. The CiscoV2 directory contains three MIBs with 64-bit performance monitoring counters:. CERENT-MSDWDM-MIB.mib, CERENT-FC-MIB.mib, and CERENT-GENERIC-PM-MIB.mib The CiscoV1 directory does not contain any 64-bit counters, but it does support the lower and higher word values used in 64-bit counters. The two directories also have somewhat different formats.

16.5 SNMP Message Types

The ONS 15454 SDH SNMP agent communicates with an SNMP management application using SNMP messages. Table 16-1 describes these messages.

Table 16-1 ONS 15454 SDH SNMP Message Types

Operation	Description
get-request	Retrieves a value from a specific variable.
get-next-request	Retrieves the value following the named variable; this operation is often used to retrieve variables from within a table. With this operation, an SNMP manager does not need to know the exact variable name. The SNMP manager searches sequentially to find the needed variable from within the MIB.
get-response	Replies to a get-request, get-next-request, get-bulk-request, or set-request sent by an NMS.
get-bulk-request	Fills the get-response with up to the max-repetition number of get-next interactions, similar to a get-next-request.
set-request	Provides remote network monitoring (RMON) MIB.
trap	Indicates that an event has occurred. An unsolicited message is sent by an SNMP agent to an SNMP manager.

16.6 SNMP Management Information Bases

Section 16.6.1 lists IETF-standard MIBs that are implemented in the ONS 15454 SDH and shows their compilation order. Section 16.6.2 lists proprietary MIBs for the ONS 15454 SDH and shows their compilation order. Section 16.6.3 contains information about the generic threshold and performance monitoring MIBs that can be used to monitor any network element (NE) contained in the network.

16.6.1 IETF-Standard MIBS for ONS 15454 SDH

Table 16-2 lists the IETF-standard MIBs implemented in the ONS 15454 SDH SNMP agents.

First compile the MIBs in Table 16-2. Compile the Table 16-3 MIBs next.

Caution If you do not compile MIBs in the correct order, one or more might not compile correctly.

Table 16-2 IETF Standard MIBs Implemented in the ONS 15454 SDH System

RFC[1] Number	Module Name	Title/Comments
—	IANAifType-MIB.mib	Internet Assigned Numbers Authority (IANA) ifType
1213	RFC1213-MIB-rfc1213.mib	Management Information Base for Network
1907	SNMPV2-MIB-rfc1907.mib	Management of TCP/IP-based Internets: MIB-II Management Information Base for Version 2 of the Simple Network Management Protocol (SNMPv2)
1253	RFC1253-MIB-rfc1253.mib	OSPF Version 2 Management Information Base
1493	BRIDGE-MIB-rfc1493.mib	Definitions of Managed Objects for Bridges (This defines MIB objects for managing MAC bridges based on the IEEE 802.1D-1990 standard between Local Area Network [LAN] segments.)
2819	RMON-MIB-rfc2819.mib	Remote Network Monitoring Management Information Base
2737	ENTITY-MIB-rfc2737.mib	Entity MIB (Version 2)
2233	IF-MIB-rfc2233.mib	Interfaces Group MIB using SMIv2
2358	EtherLike-MIB-rfc2358.mib	Definitions of Managed Objects for the Ethernet-like Interface Types
2493	PerfHist-TC-MIB-rfc2493.mib	Textual Conventions for MIB Modules Using Performance History Based on 15 Minute Intervals
2495	DS1/E1-MIB-rfc2495.mib	Definitions of Managed Objects for the DS1, E1, DS2 and E2 Interface Types
2496	DS3/E3-MIB-rfc2496.mib	Definitions of Managed Object for the DS3/E3 Interface Type
2558	SONET-MIB-rfc2558.mib	Definitions of Managed Objects for the SONET/SDH Interface Type

Table 16-2 IETF Standard MIBs Implemented in the ONS 15454 SDH System (continued)

RFC[1] Number	Module Name	Title/Comments
2674	P-BRIDGE-MIB-rfc2674.mib Q-BRIDGE-MIB-rfc2674.mib	Definitions of Managed Objects for Bridges with Traffic Classes, Multicast Filtering and Virtual LAN Extensions
3273	HC-RMON-MIB	The MIB module for managing remote monitoring device implementations, augmenting the original RMON MIB as specified in RFC 2819 and RFC 1513 and RMON-2 MIB as specified in RFC 2021

1. RFC = Request for Comment

The size of mediaIndependentOwner is limited to 32 characters.

16.6.2 Proprietary ONS 15454 SDH MIBS

Each ONS system is shipped with a software CD containing applicable proprietary MIBs. Table 16-3 lists the proprietary MIBs for the ONS 15454 SDH.

Table 16-3 ONS 15454 SDH Proprietary MIBs

MIB Number	Module Name
1	CERENT-GLOBAL-REGISTRY.mib
2	CERENT-TC.mib
3	CERENT-454.mib
4	CERENT-GENERIC.mib (not applicable to ONS 15454 SDH)
5	CISCO-SMI.mib
6	CISCO-VOA-MIB.mib
7	CERENT-MSDWDM-MIB.mib
8	CERENT-OPTICAL-MONITOR-MIB.mib
9	CERENT-HC-RMON-MIB.mib
10	CERENT-ENVMON-MIB.mib
11	CERENT-GENERIC-PM-MIB.mib

Note If you cannot compile the proprietary MIBs correctly, log into the Technical Support Website at http://www.cisco.com/techsupport or call Cisco TAC (800) 553-2447.

Note When SNMP indicates that the wavelength is unknown, it means that the corresponding card (MXP_2.5G_10E, TXP_MR_10E, MXP_2.5G_10G, TXP_MR_10G, TXP_MR_2.5G, or TXPP_MR_2.5G) works with the first tunable wavelength.

16.6.3 Generic Threshold and Performance Monitoring MIBs

In Release 7.0, a MIB called CERENT-GENERIC-PM-MIB allows network management stations (NMS) to use a single, generic MIB for accessing threshold and performance monitoring data of different interface types. The MIB is generic in the sense that it is not tied to any particular kind of interface. The MIB objects can be used to obtain threshold values, current performance monitoring (PM) counts, and historic PM statistics for each kind of monitor and any supported interval at the near end and far end.

Previously existing MIBs in the ONS 15454 SDH system provide some of these counts. For example, SDH interface 15-minute current PM counts and historic PM statistics are available using the SONET-MIB. DS-1 and DS-3 counts and statistics are available through the DS1/E1-MIB and DS-3/E3 MIB respectively. The generic MIB provides these types of information and also fetches threshold values and single-day statistics. In addition, the MIB supports optics and dense wavelength division multiplexing (DWDM) threshold and performance monitoring information.

The CERENT-GENERIC-PM-MIB is organized into three different tables:

- cerentGenericPmThresholdTable
- cerentGenericPmStatsCurrentTable
- cerentGenericPmStatsIntervalTable

The cerentGenericPmThresholdTable is used to obtain the threshold values for the monitor types. It is indexed based on the interface index (cerentGenericPmThresholdIndex), monitor type (cerentGenericPmThresholdMonType), location (cerentGenericPmThresholdLocation), and time period (cerentGenericPmThresholdPeriod). The syntax of cerentGenericPmThresholdMonType is type cerentMonitorType, defined in CERENT-TC.mib. The syntax of cerentGenericPmThresholdLocation is type cerentLocation, defined in CERENT-TC.mib. The syntax of cerentGenericPmThresholdPeriod is type cerentPeriod, defined in CERENT-TC.mib.

Threshold values can be provided in 64-bit and 32-bit formats. (For more information about 64-bit counters, see the "16.10.2 HC-RMON-MIB Support" section on page 16-18.) The 64-bit values in cerentGenericPmThresholdHCValue can be used with agents that support SNMPv2. The two 32-bit values (cerentGenericPmThresholdValue and cerentGenericPmThresholdOverFlowValue) can be used by NMSs that only support SNMPv1. The objects compiled in the cerentGenericPmThresholdTable are shown in Table 16-4.

Table 16-4 cerentGenericPmThresholdTable

Index Objects	Information Objects
cerentGenericPmThresholdIndex	cerentGenericPmThresholdValue
cerentGenericPmThresholdMonType	cerentGenericPmThresholdOverFlowValue
cerentGenericPmThresholdLocation	cerentGenericPmThresholdHCValue
cerentGenericPmThresholdPeriod	—

The second table within the MIB, cerentGenericPmStatsCurrentTable, compiles the current performance monitoring (PM) values for the monitor types. The table is indexed based on interface index (cerentGenericPmStatsCurrentIndex), monitor type (cerentGenericPmStatsCurrentMonType), location (cerentGenericPmStatsCurrentLocation) and time period (cerentGenericPmStatsCurrentPeriod). The syntax of cerentGenericPmStatsCurrentIndex is type cerentLocation, defined in CERENT-TC.mib. The syntax of cerentGenericPmStatsCurrentMonType is type cerentMonitor, defined in CERENT-TC.mib. The syntax of cerentGenericPmStatsCurrentPeriod is type cerentPeriod, defined in CERENT-TC.mib.

The cerentGenericPmStatsCurrentTable validates the current PM value using the cerentGenericPmStatsCurrentValid object and registers the number of valid intervals with historical PM statistics in the cerentGenericPmStatsCurrentValidIntervals object.

PM values are provided in 64-bit and 32-bit formats. The 64-bit values in cerentGenericPmStatsCurrentHCValue can be used with agents that support SNMPv2. The two 32-bit values (cerentGenericPmStatsCurrentValue and cerentGenericPmStatsCurrentOverFlowValue) can be used by NMS that only support SNMPv1. The cerentGenericPmStatsCurrentTable is shown in Table 16-5.

Table 16-5 cerentGenericPmStatsCurrentTable

Index Objects	Informational Objects
cerentGenericPmStatsCurrentIndex	cerentGenericPmStatsCurrentValue
cerentGenericPmStatsCurrentMonType	cerentGenericPmStatsCurrentOverFlowValue
cerentGenericPmStatsCurrentLocation	cerentGenericPmStatsCurrentHCValue
cerentGenericPmStatsCurrentPeriod	cerentGenericPmStatsCurrentValidData
—	cerentGenericPmStatsCurrentValidIntervals

The third table in the MIB, cerentGenericPmStatsIntervalTable, obtains historic PM values for the monitor types. This table is indexed based on the interface index, monitor type, location, time period, and interval number. It validates the current PM value in the cerentGenericPmStatsIntervalValid object.

This table is indexed based on interface index (cerentGenericPmStatsIntervalIndex), monitor type (cerentGenericPMStatsIntervalMonType), location (cerentGenericPmStatsIntervalLocation), and period (cerentGenericPmStatsIntervalPeriod). The syntax of cerentGenericPmStatsIntervalIndex is type cerentLocation, defined in CERENT-TC.mib. The syntax of cerentGenericPmStatsIntervalMonType is type cerentMonitor, defined in CERENT-TC.mib. The syntax of cerentGernicPmStatsIntervalPeriod is type cerentPeriod, defined in CERENT-TC.mib.

The table provides historic PM values in 64-bit and 32-bit formats. The 64-bit values contained in the cerentGenericPmStatsIntervalHCValue table can be used with SNMPv2 agents. The two 32-bit values (cerentGenericPmStatsIntervalValue and cerentGenericPmStatsIntervalOverFlowValue) can be used by SNMPv1 NMS. The cerentGenericPmStatsIntervalTable is shown in Table 16-6.

Table 16-6 cerentGenericPmStatsIntervalTable

Index Objects	Informational Objects
cerentGenericPmStatsIntervalIndex	cerentGenericPmStatsIntervalValue
cerentGenericPmStatsIntervalMonType	cerentGenericPmStatsIntervalOverFlowValue
cerentGenericPmStatsIntervalLocation	cerentGenericPmStatsIntervalHCValue
cerentGenericPmStatsIntervalPeriod	cerentGenericPmStatsIntervalValidData
cerentGenericPmStatsIntervalNumber	—

16.7 SNMP Trap Content

The ONS 15454 SDH generates all alarms and events, such as raises and clears, as SNMP traps. These contain the following information:

- Object IDs that uniquely identify each event with information about the generating entity (the slot or port; synchronous transport signal [STS] and Virtual Tributary [VT]; bidirectional line switched ring [BLSR], Spanning Tree Protocol [STP], etc.).
- Severity and service effect of the alarm (critical, major, minor, or event; service-affecting or non-service affecting).
- Date and time stamp showing when the alarm occurred.

16.7.1 Generic and IETF Traps

The ONS 15454 SDH supports the generic IETF traps listed in Table 16-7.

Table 16-7 ONS 15454 SDH Traps

Trap	From RFC No. MIB	Description
coldStart	RFC1907-MIB	Agent up, cold start.
warmStart	RFC1907-MIB	Agent up, warm start.
authenticationFailure	RFC1907-MIB	Community string does not match.
newRoot	RFC1493/ BRIDGE-MIB	Sending agent is the new root of the spanning tree.
topologyChange	RFC1493/ BRIDGE-MIB	A port in a bridge has changed from Learning to Forwarding or Forwarding to Blocking.
entConfigChange	RFC2737/ ENTITY-MIB	The entLastChangeTime value has changed.
dsx1LineStatusChange	RFC2495/ DS1/E1-MIB	The value of an instance of dsx1LineStatus has changed. The trap can be used by an NMS to trigger polls. When the line status change results from a higher-level line status change (for example, a DS-3), no traps for the DS-1 are sent.
dsx3LineStatusChange	RFC2496/ DS3/E3-MIB	The value of an instance of dsx3LineStatus has changed. This trap can be used by an NMS to trigger polls. When the line status change results in a lower-level line status change (for example, a DS-1), no traps for the lower-level are sent.
risingAlarm	RFC2819/ RMON-MIB	The SNMP trap that is generated when an alarm entry crosses the rising threshold and the entry generates an event that is configured for sending SNMP traps.
fallingAlarm	RFC2819/ RMON-MIB	The SNMP trap that is generated when an alarm entry crosses the falling threshold and the entry generates an event that is configured for sending SNMP traps.

16.7.2 Variable Trap Bindings

Each SNMP trap contains variable bindings that are used to create the MIB tables. ONS 15454 SDH traps and variable bindings are listed in Table 16-8. For each group (such as Group A), all traps within the group are associated with all of its variable bindings.

Table 16-8 ONS 15454 SDH SNMPv2 Trap Variable Bindings

Group	Trap Name(s) Associated with	Variable Binding Number	SNMPv2 Variable Bindings	Description
A	dsx1LineStatusChange (from RFC 2495)	(1)	dsx1LineStatus	This variable indicates the line status of the interface. It contains loopback, failure, received alarm and transmitted alarm information.
		(2)	dsx1LineStatusLastChange	The value of MIB II's sysUpTime object at the time this DS1/E1 entered its current line status state. If the current state was entered prior to the last proxy-agent re-initialization, the value of this object is zero.
		(3)	cerent454NodeTime	The time that an event occurred.
		(4)	cerent454AlarmState	The alarm severity and service-affecting status. Severities are Minor, Major, and Critical. Service-affecting statuses are Service-Affecting and Non-Service Affecting.
		(5)	snmpTrapAddress	The address of the SNMP trap.
B	dsx3LineStatusChange (from RFC 2496)	(1)	dsx3LineStatus	This variable indicates the line status of the interface. It contains loopback state information and failure state information.
		(2)	dsx3LineStatusLastChange	The value of MIB II's sysUpTime object at the time this DS3/E3 entered its current line status state. If the current state was entered prior to the last re-initialization of the proxy-agent, then the value is zero.
		(3)	cerent454NodeTime	The time that an event occurred.

Table 16-8 ONS 15454 SDH SNMPv2 Trap Variable Bindings (continued)

Group	Trap Name(s) Associated with	Variable Binding Number	SNMPv2 Variable Bindings	Description
B (cont.)		(4)	cerent454AlarmState	The alarm severity and service-affecting status. Severities are Minor, Major, and Critical. Service-affecting statuses are Service-Affecting and Non-Service Affecting.
		(5)	snmpTrapAddress	The address of the SNMP trap.
C	coldStart (from RFC 1907)	(1)	cerent454NodeTime	The time that the event occurred.
	warmStart (from RFC 1907)	(2)	cerent454AlarmState	The alarm severity and service-affecting status. Severities are Minor, Major, and Critical. Service-affecting statuses are Service-Affecting and Non-Service Affecting.
	newRoot (from RFC)	(3)	snmpTrapAddress	The address of the SNMP trap.
	topologyChange (from RFC)		—	—
	entConfigChange (from RFC 2737)		—	—
	authenticationFailure (from RFC 1907)		—	—
D1	risingAlarm (from RFC 2819)	(1)	alarmIndex	This variable uniquely identifies each entry in the alarm table. When an alarm in the table clears, the alarm indexes change for each alarm listed.
		(2)	alarmVariable	The object identifier of the variable being sampled.
		(3)	alarmSampleType	The method of sampling the selected variable and calculating the value to be compared against the thresholds.
		(4)	alarmValue	The value of the statistic during the last sampling period.

Table 16-8 ONS 15454 SDH SNMPv2 Trap Variable Bindings (continued)

Group	Trap Name(s) Associated with	Variable Binding Number	SNMPv2 Variable Bindings	Description
D1 (cont.)		(5)	alarmRisingThreshold	When the current sampled value is greater than or equal to this threshold, and the value at the last sampling interval was less than this threshold, a single event is generated. A single event is also generated if the first sample after this entry is greater than or equal to this threshold.
		(6)	cerent454NodeTime	The time that an event occurred.
		(7)	cerent454AlarmState	The alarm severity and service-affecting status. Severities are Minor, Major, and Critical. Service-affecting statuses are Service-Affecting and Non-Service Affecting.
		(8)	snmpTrapAddress	The address of the SNMP trap.
D2	fallingAlarm (from RFC 2819)	(1)	alarmIndex	This variable uniquely identifies each entry in the alarm table. When an alarm in the table clears, the alarm indexes change for each alarm listed.
		(2)	alarmVariable	The object identifier of the variable being sampled.
		(3)	alarmSampleType	The method of sampling the selected variable and calculating the value to be compared against the thresholds.
		(4)	alarmValue	The value of the statistic during the last sampling period.
		(5)	alarmFallingThreshold	When the current sampled value is less than or equal to this threshold, and the value at the last sampling interval was greater than this threshold, a single event is generated. A single is also generated if the first sample after this entry is less than or equal to this threshold.
		(6)	cerent454NodeTime	The time that an event occurred.

Table 16-8 ONS 15454 SDH SNMPv2 Trap Variable Bindings (continued)

Group	Trap Name(s) Associated with	Variable Binding Number	SNMPv2 Variable Bindings	Description
D2 (cont.)		(7)	cerent454AlarmState	The alarm severity and service-affecting status. Severities are Minor, Major, and Critical. Service-affecting statuses are Service-Affecting and Non-Service Affecting.
		(8)	snmpTrapAddress	The address of the SNMP trap.
E	failureDetectedExternal ToTheNE (from CERENT-454-mib)	(1)	cerent454NodeTime	The time that an event occurred.
		(2)	cerent454AlarmState	The alarm severity and service-affecting status. Severities are Minor, Major, and Critical. Service-affecting statuses are Service-Affecting and Non-Service Affecting.
		(3)	cerent454AlarmObjectType	The entity that raised the alarm. The NMS should use this value to decide which table to poll for further information about the alarm.
		(4)	cerent454AlarmObjectIndex	Every alarm is raised by an object entry in a specific table. This variable is the index of objects in each table; if the alarm is interface-related, this is the index of the interface in the interface table.
		(5)	cerent454AlarmSlotNumber	The slot of the object that raised the alarm. If a slot is not relevant to the alarm, the slot number is zero.
		(6)	cerent454AlarmPortNumber	The port of the object that raised the alarm. If a port is not relevant to the alarm, the port number is zero.
		(7)	cerent454AlarmLineNumber	The object line that raised the alarm. If a line is not relevant to the alarm, the line number is zero.
		(8)	cerent454AlarmObjectName	The TL1-style user-visible name that uniquely identifies an object in the system.

Table 16-8 ONS 15454 SDH SNMPv2 Trap Variable Bindings (continued)

Group	Trap Name(s) Associated with	Variable Binding Number	SNMPv2 Variable Bindings	Description
E (cont.)		(9)	cerent454AlarmAdditionalInfo	Additional information for the alarm object. In the current version of the MIB, this object contains provisioned description for alarms that are external to the NE. If there is no additional information, the value is zero.
		(10)	snmpTrapAddress	The address of the SNMP trap.
F	performanceMonitorThresholdCrossingAlert (from CERENT-454-mib)	(1)	cerent454NodeTime	The time that an event occurred.
		(2)	cerent454AlarmState	The alarm severity and service-affecting status. Severities are Minor, Major, and Critical. Service-affecting statuses are Service-Affecting and Non-Service Affecting.
		(3)	cerent454AlarmObjectType	The entity that raised the alarm. The NMS should use this value to decide which table to poll for further information about the alarm.
		(4)	cerent454AlarmObjectIndex	Every alarm is raised by an object entry in a specific table. This variable is the index of objects in each table; if the alarm is interface-related, this is the index of the interface in the interface table.
		(5)	cerent454AlarmSlotNumber	The slot of the object that raised the alarm. If a slot is not relevant to the alarm, the slot number is zero.
		(6)	cerent454AlarmPortNumber	The port of the object that raised the alarm. If a port is not relevant to the alarm, the port number is zero.
		(7)	cerent454AlarmLineNumber	The object line that raised the alarm. If a line is not relevant to the alarm, the line number is zero.
		(8)	cerent454AlarmObjectName	The TL1-style user-visible name that uniquely identifies an object in the system.
		(9)	cerent454ThresholdMonitorType	This object indicates the type of metric being monitored.

Table 16-8 ONS 15454 SDH SNMPv2 Trap Variable Bindings (continued)

Group	Trap Name(s) Associated with	Variable Binding Number	SNMPv2 Variable Bindings	Description
F (cont.)		(10)	cerent454ThresholdLocation	Indicates whether the event occurred at the near- or far end.
		(11)	cerent454ThresholdPeriod	Indicates the sampling interval period.
		(12)	cerent454ThresholdSetValue	The value of this object is the threshold provisioned by the NMS.
		(13)	cerent454ThresholdCurrentValue	—
		(14)	cerent454ThresholdDetectType	—
		(15)	snmpTrapAddress	The address of the SNMP trap.
G	All other traps (from CERENT-454-MIB) not listed above	(1)	cerent454NodeTime	The time that an event occurred.
		(2)	cerent454AlarmState	The alarm severity and service-affecting status. Severities are Minor, Major, and Critical. Service-affecting statuses are Service-Affecting and Non-Service Affecting.
		(3)	cerent454AlarmObjectType	The entity that raised the alarm. The NMS should use this value to decide which table to poll for further information about the alarm.
		(4)	cerent454AlarmObjectIndex	Every alarm is raised by an object entry in a specific table. This variable is the index of objects in each table; if the alarm is interface-related, this is the index of the interface in the interface table.
		(5)	cerent454AlarmSlotNumber	The slot of the object that raised the alarm. If a slot is not relevant to the alarm, the slot number is zero.
		(6)	cerent454AlarmPortNumber	The port of the object that raised the alarm. If a port is not relevant to the alarm, the port number is zero.
		(7)	cerent454AlarmLineNumber	The object line that raised the alarm. If a line is not relevant to the alarm, the line number is zero.

Table 16-8 ONS 15454 SDH SNMPv2 Trap Variable Bindings (continued)

Group	Trap Name(s) Associated with	Variable Binding Number	SNMPv2 Variable Bindings	Description
G (cont.)		(8)	cerent454AlarmObjectName	The TL1-style user-visible name that uniquely identifies an object in the system.
		(9)	snmpTrapAddress	The address of the SNMP trap.

16.8 SNMP Community Names

Community names are used to group SNMP trap destinations. All ONS 15454 SDH trap destinations can be provisioned as part of SNMP communities in Cisco Transport Controller (CTC). When community names are assigned to traps, the ONS 15454 SDH treats the request as valid if the community name matches one that is provisioned in CTC. In this case, all agent-managed MIB variables are accessible to that request. If the community name does not match the provisioned list, SNMP drops the request.

16.9 Proxy Over Firewalls

SNMP and NMS applications have traditionally been unable to cross firewalls used for isolating security risks inside or from outside networks. Release 7.0 CTC enables network operations centers (NOCs) to access performance monitoring data such as remote monitoring (RMON) statistics or autonomous messages across firewalls by using an SNMP proxy element installed on a firewall.

The application-level proxy transports SNMP protocol data units (PDU) between the NMS and NEs, allowing requests and responses between the NMS and NEs and forwarding NE autonomous messages to the NMS. The proxy agent requires little provisioning at the NOC and no additional provisioning at the NEs.

The firewall proxy is intended for use in a gateway network element-end network element (GNE-ENE) topology with many NEs through a single NE gateway. Up to 64 SNMP requests (such as get, getnext, or getbulk) are supported at any time behind single or multiple firewalls. The proxy interoperates with common NMS such as HP-OpenView.

For security reasons, the SNMP proxy feature must be enabled at all receiving and transmitting NEs to function. For instructions to do this, refer to the *Cisco ONS 15454 SDH Procedure Guide*.

16.10 Remote Monitoring

The ONS 15454 SDH incorporates RMON to allow network operators to monitor Ethernet card performance and events. The RMON thresholds are user-provisionable in CTC. Refer to the *Cisco ONS 15454 SDH Procedure Guide for instructions*. Note that otherwise, RMON operation is invisible to the typical CTC user.

ONS 15454 SDH system RMON is based on the IETF-standard MIB RFC 2819 and includes the following five groups from the standard MIB: Ethernet Statistics, History Control, Ethernet History, Alarm, and Event.

Certain statistics measured on the ML card are mapped to standard MIB if one exists else mapped to a non standard MIB variable. The naming convention used by the standarad/non-standard MIB is not the same as the statistics variable used by the card. Hence when these statistics are obtained via get-reques/get-next-request/SNMP Trap they don't match the name used on the card or as seen by CTC/TL1.

- For ex: STATS_MediaIndStatsRxFramesTooLong stats is mapped to cMediaIndependentInFramesTooLong variable in CERENT MIB. STATS_RxTotalPkts is mapped to mediaIndependentInPkts in HC-RMON-rfc3273.mib

16.10.1 64-Bit RMON Monitoring over DCC

The ONS 15454 SDH DCC is implemented over the IP protocol, which is not compatible with Ethernet. The system builds Ethernet equipment History and Statistics tables using HDLC statistics that are gathered over the DCC (running point-to-point protocol, or PPP). This release adds RMON DCC monitoring (for both IP and Ethernet) to monitor the health of remote DCC connections.

In, R7.0, the implementation contains two MIBS for DCC interfaces. They are:

- cMediaIndependentTable—standard, rfc3273; the proprietary extension of the HC-RMON MIB used for reporting statistics
- cMediaIndependentHistoryTable—proprietary MIB used to support history

16.10.1.1 Row Creation in MediaIndependentTable

The SetRequest PDU for creating a row in the mediaIndependentTable should contain all the values required to activate a row in a single set operation along with an assignment of the status variable to createRequest (2). The SetRequest PDU for entry creation must have all the object IDs (OIDs) carrying an instance value of 0. That is, all the OIDs should be of the type OID.0.

In order to create a row, the SetRequest PDU should contain the following:

- mediaIndependentDataSource and its desired value
- mediaIndependentOwner and its desired value
- mediaIndependentStatus with a value of createRequest (2)

The mediaIndependentTable creates a row if the SetRequest PDU is valid according to the above rules. When the row is created, the SNMP agent decides the value of mediaIndependentIndex. This value is not sequentially allotted or contiguously numbered. It changes when an Ethernet interface is added or deleted. The newly created row will have mediaIndependentTable value of valid (1).

If the row already exists, or if the SetRequest PDU values are insufficient or do not make sense, the SNMP agent returns an error code.

Note mediaIndependentTable entries are not preserved if the SNMP agent is restarted.

The mediaIndependentTable deletes a row if the SetRequest PDU contains a mediaIndependentStatus with a value of invalid (4). The varbind's OID instance value identifies the row for deletion. You can recreate a deleted row in the table if desired.

16.10.1.2 Row Creation in cMediaIndependentHistoryControlTable

SNMP row creation and deletion for the cMediaIndependentHistoryControlTable follows the same processes as for the MediaIndependentTable; only the variables differ.

In order to create a row, the SetRequest PDU should contain the following:

- cMediaIndependentHistoryControlDataSource and its desired value
- cMediaIndependentHistoryControlOwner and its desired value
- cMediaIndependentHistoryControlStatus with a value of createRequest (2)

16.10.2 HC-RMON-MIB Support

For the ONS 15454 SDH, the implementation of the high-capacity remote monitoring information base (HC-RMON-MIB, or RFC 3273) enables 64-bit support of existing RMON tables. This support is provided with the etherStatsHighCapacityTable and the etherHistoryHighCapacityTable. An additional table, the mediaIndependentTable, and an additional object, hcRMONCapabilities, are also added for this support. All of these elements are accessible by any third-party SNMP client having RFC 3273 support.

16.10.3 Ethernet Statistics RMON Group

The Ethernet Statistics group contains the basic statistics monitored for each subnetwork in a single table called the etherStatsTable.

16.10.3.1 Row Creation in etherStatsTable

The SetRequest PDU for creating a row in this table should contain all the values needed to activate a row in a single set operation, and an assigned status variable to createRequest. The SetRequest PDU object ID (OID) entries must all carry an instance value, or type OID, of 0.

In order to create a row, the SetRequest PDU should contain the following:

- The etherStatsDataSource and its desired value
- The etherStatsOwner and its desired value (size of this value is limited to 32 characters)
- The etherStatsStatus with a value of createRequest (2)

The etherStatsTable creates a row if the SetRequest PDU is valid according to the above rules. When the row is created, the SNMP agent decides the value of etherStatsIndex. This value is not sequentially allotted or contiguously numbered. It changes when an Ethernet interface is added or deleted. The newly created row will have etherStatsStatus value of valid (1).

If the etherStatsTable row already exists, or if the SetRequest PDU values are insufficient or do not make sense, the SNMP agent returns an error code.

Note EtherStatsTable entries are not preserved if the SNMP agent is restarted.

16.10.3.2 Get Requests and GetNext Requests

Get requests and getNext requests for the etherStatsMulticastPkts and etherStatsBroadcastPkts columns return a value of zero because the variables are not supported by ONS 15454 SDH Ethernet cards.

16.10.3.3 Row Deletion in etherStatsTable

To delete a row in the etherStatsTable, the SetRequest PDU should contain an etherStatsStatus “invalid” value (4). The OID marks the row for deletion. If required, a deleted row can be recreated.

16.10.3.4 64-Bit etherStatsHighCapacity Table

The Ethernet statistics group contains 64-bit statistics in the etherStatsHighCapacityTable, which provides 64-bit RMON support for the HC-RMON-MIB. The etherStatsHighCapacityTable is an extension of the etherStatsTable that adds 16 new columns for performance monitoring data in 64-bit format. There is a one-to-one relationship between the etherStatsTable and etherStatsHighCapacityTable when rows are created or deleted in either table.

16.10.4 History Control RMON Group

The History Control group defines sampling functions for one or more monitor interfaces in the historyControlTable. The values in this table, as specified in RFC 2819, are derived from the historyControlTable and etherHistoryTable.

16.10.4.1 History Control Table

The RMON is sampled at one of four possible intervals. Each interval, or period, contains specific history values (also called buckets). Table 16-9 lists the four sampling periods and corresponding buckets.

The historyControlTable maximum row size is determined by multiplying the number of ports on a card by the number of sampling periods. For example, an ONS 15454 SDH E100 card contains 24 ports, which multiplied by periods allows 96 rows in the table. An E1000 card contains 14 ports, which multiplied by four periods allows 56 table rows.

Table 16-9 RMON History Control Periods and History Categories

Sampling Periods (historyControlValue Variable)	Total Values, or Buckets (historyControl Variable)
15 minutes	32
24 hours	7
1 minute	60
60 minutes	24

16.10.4.2 Row Creation in historyControlTable

The SetRequest PDU must be able to activate a historyControlTable row in one single-set operation. In order to do this, the PDU must contain all needed values and have a status variable value of 2 (createRequest). All OIDs in the SetRequest PDU should be type OID.0 type for entry creation.

To create a creation SetRequest PDU for the historyControlTable, the following values are required:

- The historyControlDataSource and its desired value
- The historyControlBucketsRequested and it desired value
- The historyControlInterval and its desired value
- The historyControlOwner and its desired value
- The historyControlStatus with a value of createRequest (2)

The historyControlBucketsRequested OID value is ignored because the number of buckets allowed for each sampling period, based upon the historyControlInterval value, is already fixed as listed in Table 16-9.

The historyControlInterval value cannot be changed from the four allowed choices. If you use another value, the SNMP agent selects the closest smaller time period from the set buckets. For example, if the set request specifies a 25-minute interval, this falls between the 15-minute (32 bucket) variable and the 60-minute (24 bucket) variable. The SNMP agent automatically selects the lower, closer value, which is 15 minutes, so it allows 32 buckets.

If the SetRequest PDU is valid, a historyControlTable row is created. If the row already exists, or if the SetRequest PDU values do not make sense or are insufficient, the SNMP agent does not create the row and returns an error code.

16.10.4.3 Get Requests and GetNext Requests

These PDUs are not restricted.

16.10.4.4 Row Deletion in historyControl Table

To delete a row from the table, the SetRequest PDU should contain a historyControlStatus value of 4 (invalid). A deleted row can be recreated.

16.10.5 Ethernet History RMON Group

The ONS 15454 SDH implements the etherHistoryTable as defined in RFC 2819. The group is created within the bounds of the historyControlTable and does not deviate from the RFC in its design.

64-bit Ethernet history for the HC-RMON-MIB is implemented in the etherHistoryHighCapacityTable, which is an extension of the etherHistoryTable. The etherHistoryHighCapacityTable adds four columns for 64-bit performance monitoring data. These two tables have a one-to-one relationship. Adding or deleting a row in one table will effect the same change in the other.

16.10.6 Alarm RMON Group

The Alarm group consists of the alarmTable, which periodically compares sampled values with configured thresholds and raises an event if a threshold is crossed. This group requires the implementation of the event group, which follows this section.

16.10.6.1 Alarm Table

The NMS uses the alarmTable to determine and provision network performance alarmable thresholds.

16.10.6.2 Row Creation in alarmTable

To create a row in the alarmTable, the SetRequest PDU must be able to create the row in one single-set operation. All OIDs in the SetRequest PDU should be type OID.0 type for entry creation. The table has a maximum number of 256 rows.

To create a creation SetRequest PDU for the alarmTable, the following values are required:

- The alarmInterval and its desired value
- The alarmVariable and its desired value
- The alarmSampleType and its desired value
- The alarmStartupAlarm and its desired value
- The alarmOwner and its desired value
- The alarmStatus with a value of createRequest (2)

If the SetRequest PDU is valid, a historyControlTable row is created. If the row already exists, or if the SetRequest PDU values do not make sense or are insufficient, the SNMP agent does not create the row and returns an error code.

In addition to the required values, the following restrictions must be met in the SetRequest PDU:

- The alarmOwner is a string of length 32 characters.
- The alarmRisingEventIndex always takes value 1.
- The alarmFallingEventIndex always takes value 2.
- The alarmStatus has only two values supported in SETs: createRequest (2) and invalid (4).
- The AlarmVariable is of the type OID.ifIndex, where ifIndex gives the interface this alarm is created on and OID is one of the OIDs supported in Table 16-10.

Table 16-10 OIDs Supported in the Alarm Table

No.	Column Name	OID	Status
1	ifInOctets	{1.3.6.1.2.1.2.2.1.10}	—
2	IfInUcastPkts	{1.3.6.1.2.1.2.2.1.11}	—
3	ifInMulticastPkts	{1.3.6.1.2.1.31.1.1.1.2}	Unsupported in E100/E1000
4	ifInBroadcastPkts	{1.3.6.1.2.1.31.1.1.1.3}	Unsupported in E100/E1000
5	ifInDiscards	{1.3.6.1.2.1.2.2.1.13}	Unsupported in E100/E1000
6	ifInErrors	{1.3.6.1.2.1.2.2.1.14}	—
7	ifOutOctets	{1.3.6.1.2.1.2.2.1.16}	—
8	ifOutUcastPkts	{1.3.6.1.2.1.2.2.1.17}	—
9	ifOutMulticastPkts	{1.3.6.1.2.1.31.1.1.1.4}	Unsupported in E100/E1000
10	ifOutBroadcastPkts	{1.3.6.1.2.1.31.1.1.1.5}	Unsupported in E100/E1000
11	ifOutDiscards	{1.3.6.1.2.1.2.2.1.19}	Unsupported in E100/E1000
12	Dot3StatsAlignmentErrors	{1.3.6.1.2.1.10.7.2.1.2}	—
13	Dot3StatsFCSErrors	{1.3.6.1.2.1.10.7.2.1.3}	—
14	Dot3StatsSingleCollisionFrames	{1.3.6.1.2.1.10.7.2.1.4}	—
15	Dot3StatsMultipleCollisionFrames	{1.3.6.1.2.1.10.7.2.1.5}	—

Table 16-10 OIDs Supported in the Alarm Table (continued)

No.	Column Name	OID	Status
16	Dot3StatsDeferredTransmissions	{1.3.6.1.2.1.10.7.2.1.7}	—
17	Dot3StatsLateCollisions	{1.3.6.1.2.1.10.7.2.1.8}	—
18	Dot3StatsExcessiveCollisions	{13.6.1.2.1.10.7.2.1.9}	—
19	Dot3StatsFrameTooLong	{1.3.6.1.2.1.10.7.2.1.13}	—
20	Dot3StatsCarrierSenseErrors	{1.3.6.1.2.1.10.7.2.1.11}	Unsupported in E100/E1000
21	Dot3StatsSQETestErrors	{1.3.6.1.2.1.10.7.2.1.6}	Unsupported in E100/E1000
22	etherStatsUndersizePkts	{1.3.6.1.2.1.16.1.1.1.9}	—
23	etherStatsFragments	{1.3.6.1.2.1.16.1.1.1.11}	—
24	etherStatsPkts64Octets	{1.3.6.1.2.1.16.1.1.1.14}	—
25	etherStatsPkts65to127Octets	{1.3.6.1.2.1.16.1.1.1.15}	—
26	etherStatsPkts128to255Octets	{1.3.6.1.2.1.16.1.1.1.16}	—
27	etherStatsPkts256to511Octets	{1.3.6.1.2.1.16.1.1.1.17}	—
28	etherStatsPkts512to1023Octets	{1.3.6.1.2.1.16.1.1.1.18}	—
29	etherStatsPkts1024to1518Octets	{1.3.6.1.2.1.16.1.1.1.19}	—
30	EtherStatsBroadcastPkts	{1.3.6.1.2.1.16.1.1.1.6}	—
31	EtherStatsMulticastPkts	{1.3.6.1.2.1.16.1.1.1.7}	—
32	EtherStatsOversizePkts	{1.3.6.1.2.1.16.1.1.1.10}	—
33	EtherStatsJabbers	{1.3.6.1.2.1.16.1.1.1.12}	—
34	EtherStatsOctets	{1.3.6.1.2.1.16.1.1.1.4}	—
35	EtherStatsCollisions	{1.3.6.1.2.1.16.1.1.1.13}	—
36	EtherStatsCollisions	{1.3.6.1.2.1.16.1.1.1.8}	—
37	EtherStatsDropEvents	{1.3.6.1.2.1.16.1.1.1.3}	Unsupported in E100/E1000 and G1000

16.10.6.3 Get Requests and GetNext Requests

These PDUs are not restricted.

16.10.6.4 Row Deletion in alarmTable

To delete a row from the table, the SetRequest PDU should contain an alarmStatus value of 4 (invalid). A deleted row can be recreated. Entries in this table are preserved if the SNMP agent is restarted.

16.10.7 Event RMON Group

The Event group controls event generation and notification. It consists of two tables: the eventTable, which is a read-only list of events to be generated, and the logTable, which is a writable set of data describing a logged event. The ONS 15454 SDH implements the logTable as specified in RFC 2819.

16.10.7.1 Event Table

The eventTable is read-only and unprovisionable. The table contains one row for rising alarms and another for falling ones. This table has the following restrictions:

- The eventType is always log-and-trap (4).
- The eventCommunity value is always a zero-length string, indicating that this event causes the trap to be despatched to all provisioned destinations.
- The eventOwner column value is always “monitor.”
- The eventStatus column value is always valid(1).

16.10.7.2 Log Table

The logTable is implemented exactly as specified in RFC 2819. The logTable is based upon data that is locally cached in a controller card. If there is a controller card protection switch, the existing logTable is cleared and a new one is started on the newly active controller card. The table contains as many rows as provided by the alarm controller.

Hardware Specifications

This appendix contains hardware and software specifications for the ONS 15454 SDH.

A.1 Shelf Specifications

This section provides specifications for shelf bandwidth; a list of topologies; Cisco Transport Controller (CTC) specifications; LAN, TL1, modem, alarm, and electrical interface assembly (EIA) interface specifications; database, timing, power, and environmental specifications; and shelf dimensions.

A.1.1 Bandwidth

The ONS 15454 SDH has the following bandwidth specifications:

- Total bandwidth: 240 Gbps
- Data plane bandwidth: 160 Gbps
- SDH plane bandwidth: 80 Gbps

A.1.2 Configurations

The ONS 15454 SDH can be configured as follows:

- Digital cross-connect
- Terminal mode
- Linear add-drop multiplexer (ADM)
- Two-fiber multiplex section-shared protection ring (MS-SPRing)
- Four-fiber MS-SPRing
- Multiring interconnection
- Subnetwork connection protection (SNCP)
- Extended SNCP
- Virtual rings
- Hybrid SDH network topology
- Regenerator mode

- Wavelength multiplexer

A.1.3 Cisco Transport Controller

CTC, the ONS 15454 SDH craft interface software, has the following specifications:

- 10BaseT
- TCC2/TCC2P access: RJ-45 connector
- Front Mount Electrical Connection (FMEC) access: LAN connector on MIC-C/T/P faceplate

A.1.4 External LAN Interface

The ONS 15454 SDH external LAN interface has the following specifications:

- 10BaseT Ethernet
- FMEC access: LAN connector on MIC-C/T/P faceplate

A.1.5 Alarm Interface

The ONS 15454 SDH alarm interface has the following specifications:

- Visual: Critical, Major, Minor, Remote
- Audible: Critical, Major, Minor, Remote
- Alarm inputs: Common 32-VDC output for all alarm-inputs, closed contact limited to 2 mA
- Control outputs: Open contact maximum 60 VDC, closed contact maximum 100 mA
- FMEC access: 62-Pin DB connector on the MIC-A/P faceplate

A.1.6 Database Storage

The ONS 15454 SDH has the following database storage specifications:

- Nonvolatile memory: 128 MB, 3.0 V flash memory

A.1.7 Timing Interface

The ONS 15454 SDH timing interface has the following specifications:

- 2 coaxial inputs
- 2 coaxial outputs
- FMEC access: 1.0/2.3 miniature coax connectors on the MIC-C/T/P faceplate

A.1.8 System Timing

The ONS 15454 SDH has the following system timing specifications:

- Stratum 3E, per ITU-T G.813
- Free running accuracy: +/– 4.6 ppm
- Holdover stability: 3.7 exp –7/day, including temperature (< 255 slips in first 24 hours)
- Reference: External building integrated timing supply (BITS), line, internal

A.1.9 System Power

The ONS 15454 SDH has the following power specifications:

- Input voltage: –48 VDC
- Maximum Current Rating: 24 A (at –48 VDC)
- Power requirements:
  - Nominal: –48 VDC
  - Tolerance limits: –40.5 to –57.0 VDC
- Power terminals: 3WK3 Combo-D power cable connector (MIC-A/P and MIC-C/T/P faceplates)
- Fusing: Maximum 30 A fuse panel

A.1.10 System Environmental Specifications

The ONS 15454 SDH has the following environmental specifications:

- Operating temperature: 0 to +40 degrees Celsius (32 to 104 degrees Fahrenheit)
- Operating humidity: 5 to 95 percent, noncondensing

A.1.11 Dimensions

The ONS 15454 SDH shelf assembly has the following dimensions:

- Height: 616.5 mm (24.27 in.)
- Width: 535 mm (17 in.) without mounting ears attached
- Depth: 280 mm (11.02 in.)
- Weight: 26 kg (57.3 lb) empty

A.2 SFP and XFP Specifications

Table A-1 lists the specifications for the available Small Form-factor Pluggables (SFPs) and 10 Gbps Pluggables (XFPs). In the table, the following acronyms are used:

- ESCON = Enterprise System Connection
- FICON = fiber connectivity

- GE = Gigabit Ethernet
- FC = Fibre Channel
- HDTV = high definition television
- DWDM = dense wavelength division multiplexing
- CWDM = coarse wavelength division multiplexing

Table A-1 SFP and XFP Specifications

SFP/XFP Product ID	Interface	Transmitter Output Power Min/Max (dBm)	Receiver Input Power Min/Max (dBm)
15454-SFP-LC-SX/ 15454E-SFP-LC-SX	GE	–9.5 to –4	–17 to 0
15454-SFP-LC-LX/ 15454E-SFP-LC-LX	GE	–9.5 to –3	–19 to –3
15454-SFP3-1-IR=	OC-3	–15 to –8	–23 to –8
15454E-SFP-L.1.1=	STM-1	–15 to –8	–34 to –10
15454-SFP12-4-IR=	OC-12, D1 Video	–15 to –8	–28 to –7
15454E-SFP-L.4.1=	STM-4, D1 Video	–15 to –8	–28 to –8
15454-SFP-OC48-IR=	OC-48, DV6000 (C-Cor)	–5 to +0	–18 to +0
ONS-SE-2G-S1=	OC-48, STM-16	–10 to –3	–18 to –3
15454E-SFP-L.16.1=	STM-16, DV6000 (C-Cor)	–5 to +0	–18 to +0
15454-SFP-200/ 15454E-SFP-200	ESCON	–8 to –4	–28 to –3
15454-SFP-GEFC-SX=/ 15454E-SFP-GEFC-S=	FC (1 and 2 Gbps), FICON, GE	–10 to –3.5	–17 to 0 (1FC and 1GE) –15 to 0 (2FC)
15454-SFP-GE+-LX=/ 15454E-SFP-GE+-LX=	FC (1 and 2 Gbps), FICON, GE, HDTV	–9.5 to –3.0	–20 to –3 (1FC, 1GE, and 2FC)
ONS-SE-200-MM=	ESCON	–20.5 to –15	–14 to –29[1]
ONS-SE-G2F-SX=	Fibre Channel (1 and 2 Gbps), GE	–9.5 to 0 (GE) –10 to –3.5 (1G and 2G FC/FICON)	–17 to 0[2] (GE) –22 (1G FC/FICON) –20 (2G FC/FICON)
ONS-SE-G2F-LX=	Fibre Channel (1 and 2 Gbps), FICON, GE, HDTV	–9.5 to –3 (GE) –10 to –3.5 (1FC, 2FC, and FICON)	–19 to –3[3] (GE) –22 (1G FC/FICON) –21 (2G FC/FICON)
ONS-SC-GE-SX=	GE	–9.5 to 0	–17 to 0[2]
ONS-SC-GE-LX=	GE	–9.5 to–3	–19 to –3[3]
ONS-SI-2G-S1	OC-48 SR	–10 to –3	–18 to –3
ONS-SI-2G-I1	OC-48 IR1	–5 to 0	–18 to 0
ONS-SI-2G-L1	OC-48 LR1	–2 to 3	–27 to –9
ONS-SI-2G-L2	OC-48 LR2	–2 to 3	–28 to –9

Table A-1 SFP and XFP Specifications (continued)

SFP/XFP Product ID	Interface	Transmitter Output Power Min/Max (dBm)	Receiver Input Power Min/Max (dBm)
ONS-SC-2G-30.3 through ONS-SC-2G-60.6	OC-48 DWDM	0 to 4	–28 to –9
ONS-SI-622-I1	OC-3/OC-12 IR1 Dual rate	–15 to –8	–28 to –8
ONS-SI-622-L1	OC-21 LR1	–3 to 2	–28 to –8
ONS-SI-622-L2	OC-12 LR2	–3 to 2	–28 to –8
ONS-SE-622-1470 through ONS-SE-622-1610	OC-12 CWDM	0 to 5	–28 to –7
ONS-SI-155-I1	OC-3 IR1	–15 to –8	–28 to –8
ONS-SI-155-L1	OC-3 LR1	–5 to 0	–34 to –10
ONS-SI-155-L2	OC-3 LR2	–5 to 0	–34 to –10
ONS_SE-155-1470 through ONS-SE-155-1610	OC-3 CWDM	0 to 5	–34 to –7
ONS-XC-10G-S1	OC-192 SR1	–6 to –1	–11 to –1
ONS-XC-10G-I2	OC-192 IR2	–1 to +2	–14 to +2
ONS-XC-10G-L2	OC-192 LR2	0 to 4	–24 to –7
ONS-SE-100-FX	Fast Ethernet	–20 to –14	–30 to –14
ONS-SE-100-LX10	Fast Ethernet	–15 to –8	–25 to –8

1. Based on any valid 8B/10B code pattern measured at, or extrapolated to, 10E-15 BER measured at center of eye
2. Minimum Stressed Sensitivity (10-12): -12.5(62.5um) and -13.5(50um) dBm
3. Minimum Stressed Sensitivity (10^{-12}): -14.4 dBm

A.3 General Card Specifications

This section provides power consumption and temperature ranges for all ONS 15454 SDH cards.

A.3.1 Power Consumption

Table A-2 provides power consumption information for the ONS 15454 SDH cards.

Table A-2 Individual Card Power Requirements

Card Type	Card Name	Watts	Amperes	BTU/Hr
Control Cards	TCC2	18.72	0.39 (0.213 at –60 V)	63.88
	TCC2P	27.00	0.56	92.2
	XC-VXL-10G	54.24	1.13	185.07
	XC-VXL-2.5G	81.30	1.69	277.6
	XC-VXC-10G	67	1.4	228.62
	AIC-I	4.80	0.10	16.38
	Fan Tray –48 VDC	129.60	2.7	442.21
Electrical Cards	E1-N-14	13.44	0.28	45.86
	E1-42	43.2	0.90	147.40
	E3-12	38.20	0.92	130.35
	DS3i-N-12	19.0	0.80	64.83
	STM1E-12	59.40	1.24	202.8
	FMEC-E1	0.00	0.00	0.0
	FMEC-DS1/E1	0.00	0.00	0.0
Electrical Cards	FMEC E1-120NP	0.00	0.00	0.0
	FMEC E1-120PROA	–0.1	through E1-42	—
	FMEC E1-120PROB	–0.1	through E1-42	—
	E1-75/120	0.00	0.00	0.0
	FMEC-E3/DS3	0.00	0.00	0.0
	FMEC STM1E 1:1	–8.8	through STM1E-12	—
	MIC-A/P	–0.13	through TCC2/TCC2P	—
	MIC-C/T/P	–0.38	through TCC2/TCC2P	—

Table A-2 Individual Card Power Requirements (continued)

Card Type	Card Name	Watts	Amperes	BTU/Hr
Optical Cards	OC3 IR 4/STM1 SH 1310	19.20	0.40	65.6
	OC3IR/STM1SH 1310-8	23.00	0.48	78.5
	OC12 IR/STM4 SH 1310	9.28	0.19	31.7
	OC12 LR/STM4 LH 1310	9.28	0.19	31.7
	OC12 LR/STM4 LH 1550	9.28	0.19	31.7
	OC12 LR/STM4 SH 1310-4	35.60	0.74	121.6
	OC48 IR/STM16 SH AS 1310	37.20	0.78	127.0
	OC48 LR/STM16 LH AS 1550	37.20	0.78	127.0
	OC48 ELR/STM16 EH 100 GHz	31.20	0.65	106.5
	OC192 SR/STM64 IO 1310	42.00	0.88	143.4
	OC192 IR/STM64 SH 1550	44.00	0.92	150.2
	OC192 LR/STM64 LH 1550	72.20	1.50	246.5
	OC192 LR/STM64 LH ITU 15xx.xx	46.00	0.96	157.1
	15454_MRC-12	38	0.79	129.66
	OC192SR1/STM64IO Short Reach and OC192/STM64 Any Reach[1]	40	0.83	136.49
Ethernet Cards	E100T-G	60.96	1.27	208.00
	E1000-2-G	38.88 (inlcuding GBICs)	0.81	182.67
	G1K-4	55.20 (including GBICs)	1.15	215.11
	ML100T-12	53.00	1.10	181.0
	ML1000-2	44.1(including SFPs)	0.92	167.3
	ML100X-8	65	1.35	221.93
	CE-100T-8	53.14	1.10	181.3
	CE-1000-4	60	1.25	204.80
Storage Access Networking	FC_MR-4 (Fibre Channel)	60	1.25	204.80

1. These cards are referred to as OC192-XFP in CTC.

A.3.2 Temperature Ranges

Table A-3 provides temperature ranges and product names for ONS 15454 SDH cards.

Note The I-Temp symbol is displayed on the faceplate of an I-Temp compliant card. A card without this symbol is C-Temp compliant.

Table A-3 Card Temperature Ranges and Product Names

Card Type	Card Name	C-Temp Product Name (0 to +55 degrees Celsius, 32 to 131 degrees Fahrenheit)	I-Temp Product Name (–40 to +65 degrees Celsius, –40 to 149 degrees Fahrenheit)
Control Cards	TCC2	—	15454-TCC2
	TCC2P	—	15454-TCC2P
	XC-VXL-10G	15454E-XC-VXL10G	—
	XC-VXL-2.5G	15454E-XC-VXL-2.5G	—
	XC-VXC-10G	—	15454-XC-VXC-10G-T
	AIC-I	—	15454-AIC-I
Electrical	E1-N-14	15454E-E1N-14	—
	E1-42	15454E-1-42	—
	E3-12	15454E-3-12	—
	DS3i-N-12	15454E-DS3i-N-12	—
	STM1E-12	15454E-STM1E-12	—
	FMEC-E1	15454E-FMEC-E1	—
	FMEC-DS1/E1	15454E-FMEC-DS1/E1	—
	FMEC E1-120NP	15454E-FMEC E1-120NP	—
	FMEC E1-120PROA	15454E-FMEC E1-120PROA	—
	FMEC E1-120PROB	15454E-FMEC E1-120PROB	—
	E1-75/120	15454E-E1-75/120	—
	FMEC-E3/DS3	15454E-FMEC-E3/DS3	—
	FMEC STM1E 1:1	15454E-FMEC STM1E 1:1	—
	MIC-A/P	15454E-MIC-A/P	—
	MIC-C/T/P	15454E-MIC-C/T/P	—

Table A-3 Card Temperature Ranges and Product Names (continued)

Card Type	Card Name	C-Temp Product Name (0 to +55 degrees Celsius, 32 to 131 degrees Fahrenheit)	I-Temp Product Name (–40 to +65 degrees Celsius, –40 to 149 degrees Fahrenheit)
Optical	OC3 IR 4/STM1 SH 1310	15454E-S1.1-4	—
	OC3 IR/STM1 SH 1310-8	15454E-S1.1-8	—
	OC12 IR/STM4 SH 1310	15454E-S4.1-1	—
	OC12 LR/STM4 LH 1310	15454E-L4.1-1	—
	OC12 LR/STM4 LH 1550	15454E-L4.2-1	—
	OC12 LR/STM4 SH 1310-4	15454E-L4.1-4	—
	OC48 IR/STM16 SH AS 1310	15454E-S16.1-1	—
	OC48 LR/STM16 LH AS 1550	15454E-S16.2-1	—
	OC48 ELR/STM16 EH 100 GHz	15454E-EL16HXXXX	—
	OC192 SR/STM64 IO 1310	15454E-I65.1	—
	OC192 IR/STM64 SH 1550	15454E-S64.2	—
	OC192 LR/STM64 LH 1550	15454E-L64.2.1	—
	OC192 LR/STM64 LH ITU 15xx.xx	15454E-64-LXX.X	—
	15454_MRC-12	—	15454-MRC-12-T
	OC192SR1/STM64IO Short Reach and OC192/STM64 Any Reach[1]	15454_OC192SR1/ STM64IO Short Reach and 15454_OC192/ STM64 Any Reach	—
Ethernet	E100T-G	15454-E100T-G	—
	E1000-2-G	15454-E1000-2-G	—
	G1K-4	15454-G1K-4	—
	ML100T-12	15454-ML100T-12	—
	ML1000-2	15454-ML1000-2	—
	ML100X-8	—	15454-ML100X-8
	CE-100T-8	15454-CE100T-8	—
	CE-1000-4	15454-CE1000-4	—
Storage Access Networking	FC_MR-4	15454-FC_MR-4	—

1. These cards are referred to as OC192-XFP in CTC.

A.4 Common Control Card Specifications

This section provides specifications for the common control cards.

For compliance information, refer to the *Cisco Optical Transport Products Safety and Compliance Information* document.

A.4.1 TCC2 Card Specifications

The TCC2 card has the following specifications:

- CTC software
  - Interface: EIA/TIA-232 (local craft access, on TCC2 faceplate)
  - Interface: 10BaseT LAN (on TCC2 faceplate)
  - Interface: 10BaseT LAN (through backplane, access on the MIC-A/P card)
- Synchronization
  - Stratum 3, per ITU-T G.812
  - Free running access: Accuracy +/– 4.6 ppm
  - Holdover stability: 3.7 * 10 exp – 7 per day including temperature (< 255 slips in first 24 hours)
  - Reference: External BITS, line, internal
- Supply voltage monitoring
  - Both supply voltage inputs are monitored
  - Normal operation:

    –40.5 to –56.7 V (in –48 VDC systems)

    –50.0 to –72.0 V (in –60 VDC systems)
  - Undervoltage: Major alarm
  - Overvoltage: Major alarm
- Environmental
  - Operating temperature: –40 to +55 degrees Celsius (–40 to +149 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 26.00 W, 0.54 A at –48 V, 0.43 A at –60 V, 88.8 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Depth with backplane connector: 235 mm (9.250 in.)
  - Weight (not including clam shell): 0.7 kg (1.5 lb)

A.4.2 TCC2P Card Specifications

The TCC2P card has the following specifications:

- CTC software
  - Interface: EIA/TIA-232 (local craft access, on TCC2P faceplate)
  - Interface: 10BaseT LAN (on TCC2P faceplate)
  - Interface: 10BaseT LAN (through backplane, access on the MIC-A/P card)

- Synchronization
  - Stratum 3, per ITU-T G.812
  - Free running access: Accuracy +/– 4.6 ppm
  - Holdover stability: 3.7 * 10 exp – 7 per day including temperature (< 255 slips in first 24 hours)
  - Reference: External BITS, line, internal
- Supply voltage monitoring
  - Both supply voltage inputs are monitored
  - Normal operation:

    –40.5 to –56.7 V (in –48 VDC systems)

    –50.0 to –72.0 V (in –60 VDC systems)
  - Undervoltage: Major alarm
  - Overvoltage: Major alarm
- Environmental
  - Operating temperature: –40 to +55 degrees Celsius (–40 to +149 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 26.00 W, 0.54 A at –48 V, 0.43 A at –60 V, 88.8 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Depth with backplane connector: 235 mm (9.250 in.)
  - Weight (not including clam shell): 0.7 kg (1.5 lb)

A.4.3 XC-VXL-10G Card Specifications

The XC-VXL-10G card has the following specifications:

- Environmental
  - Operating temperature: –5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
  - Operating humidity: 5 to 85 percent, noncondensing
  - Power consumption: 81.30 W, 1.69 A at –48 V, 277.6 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Depth with backplane connector: 235 mm (9.250 in.)
  - Weight (not including clam shell): 0.6 kg (1.5 lb)

A.4.4 XC-VXL-2.5G Card Specifications

The XC-VXL-2.5G card has the following specifications:

- Environmental
  - Operating temperature: –5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
  - Operating humidity: 5 to 85 percent, noncondensing
  - Power consumption: 81.30 W, 1.69 A at –48 V, 277.6 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Depth with backplane connector: 235 mm (9.250 in.)
  - Weight (not including clam shell): 0.6 kg (1.5 lb)

A.4.5 XC-XVC-10G Card Specifications

- Environmental
  - Operating temperature:

    I-Temp (15454-XC-VXC-10G-T): –40 to 149 degrees Fahrenheit (–40 to +55 degrees Celsius)
  - Operating humidity: 5 to 85 percent, noncondensing
  - Power consumption: 67 W, 1.25 A, 204.73 BTU/hr
- Dimensions
  - Height: 12.650 in. (321.3 mm)
  - Width: 0.716 in. (18.2 mm)
  - Depth: 9.000 in. (228.6 mm)
  - Weight (not including clam shell): 1.5 lb (0.6 kg)

A.4.6 AIC-I Specifications

The AIC-I card has the following specifications:

- Alarm inputs
  - Number of inputs: 16
  - Opto-coupler isolated
  - Label customer provisionable
  - Severity customer provisionable
  - Common 32-V output for all alarm-inputs
  - Each input limited to 2 mA
  - Termination through MIC-A/P

- Alarm outputs
  - Number of outputs: 4 (user configurable as inputs)
  - Switched by opto-MOS (metal oxide semiconductor)
  - Triggered by definable alarm condition
  - Maximum allowed open circuit voltage: 60 VDC
  - Maximum allowed closed circuit current: 100 mA
  - Termination through MIC-A/P
- EOW/LOW
  - ITU-T G.711, ITU-T G.712, Telcordia GR-253-CORE
  - A-law, mu-law

Note Due to the nature of mixed coding, in a mixed-mode configuration (A-law/mu-law) the orderwire is not ITU-T G.712 compliant.

  - Orderwire party line
  - Dual tone multifrequency (DTMF) signaling
- User data channel (UDC)
  - Bit rate: 64 kbps, codirectional
  - ITU-T G.703
  - Input/output impedance: 120 ohms
  - Termination: RJ-11 connectors
- Generic communications channel (GCC)
  - Bit rate: 576 kbps
  - EIA/TIA-485/V11
  - Input/output impedance: 120 ohms
  - Termination: RJ-45 connectors
- ACC connection for additional alarm interfaces
  - For future use
- Environmental
  - Operating temperature: –40 to +55 degrees Celsius (–40 to +149 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 8.00 W, 0.17 A, 27.3 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Weight (not including clam shell): 1.8 lb (0.82 kg)

A.5 Electrical Card and FMEC Specifications

This section provides specifications for the electrical and Front Mount Electrical Connection (FMEC) cards.

For compliance information, refer to the Cisco Optical Transport Products Safety and Compliance Information document.

A.5.1 E1-N-14 Card Specifications

The E1-N-14 card has the following specifications:

- E1-N-14 input
  - Bit rate: 2.048 Mbps +/–50 ppm
  - Frame format: Unframed, ITU-T G.704 framed
  - Line code: HDB-3
  - Termination: Through FMEC-E1 (for 75 ohms unbalanced) or FMEC-DS1/E1 (for 120 ohms balanced)
  - Input impedance: 75 ohms unbalanced or 120 ohms balanced
  - Cable loss: 0 to 6 dB at 1024 kHz (for cable length, see the specification of the cable that you are using)
  - AIS: ITU-T G.704 compliant
- E1-N-14 output
  - Bit rate: 2.048 Mbps +/–50 ppm
  - Frame format: Unframed, ITU-T G.704 framed
  - Line code: HDB-3
  - Termination: Through FMEC-E1 (for 75 ohms unbalanced) or FMEC-DS1/E1 (for 120 ohms balanced)
  - Output impedance: 75 ohms unbalanced or 120 ohms balanced
  - Alarm indication signal (AIS): ITU-T G.704 compliant
  - Pulse shape: conforms to ITU-T Recommendation G.703 (1991), Section 6.2, Figure 15
  - Pulse amplitude: 2.37 V +/– 5 percent zero-peak at 75 ohms; 3 V +/–5 percent zero-peak at 120 ohms
  - Loopback modes: Terminal and facility
- Environmental
  - Overvoltage protection: As in ITU-T G.703 Annex B
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 24.00 W, 0.50 A at –48 V, 81.9 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)

  - Depth: 228.6 mm (9.000 in.)
  - Depth with backplane connector: 235 mm (9.250 in.)
  - Weight (not including clam shell): 0.8 kg (1.9 lb)

A.5.2 E1-42 Card Specifications

The E1-42 card has the following specifications:

- E1-42 input
  - Bit rate: 2.048 Mbps +/–50 ppm
  - Frame format: Unframed, ITU-T G.704 framed
  - Line code: HDB-3
  - Termination: Through FMEC E1-120NP, FMEC E1-120PROA, or FMEC E1-120PROB
  - Input impedance: 120 ohms balanced (75 ohms unbalanced with additional E1-75/120)
  - Cable loss: 0 to 6 dB at 1024 kHz (for cable length, see the specification of the cable that you are using)
  - AIS: ITU-T G.704 compliant
- E1-42 output
  - Bit rate: 2.048 Mbps +/–50 ppm
  - Frame format: Unframed, ITU-T G.704 framed
  - Line code: HDB-3
  - Termination: Through FMEC E1-120NP, FMEC E1-120PROA, or FMEC E1-120PROB
  - Output impedance: 120 ohms balanced (75 ohms unbalanced with additional E1-75/120)
  - AIS: ITU-T G.704 compliant
  - Pulse shape: conforms to ITU-T Recommendation G.703 (1991), Section 6.2, Figure 15
  - Pulse amplitude: 3 V +/– 5 percent zero-peak at 120 ohms; 2.37 V +/–5 percent zero-peak at 75 ohms
  - Loopback modes: Terminal and facility
- Environmental
  - Overvoltage protection: As in ITU-T G.703 Annex B
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 38.10 W, 0.79 A at –48 V, 130.1 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Depth with backplane connector: 235 mm (9.250 in.)
  - Weight (not including clam shell): 0.8 kg (1.9 lb)

A.5.3 E3-12 Card Specifications

The E3-12 card has the following specifications:

- E3-12 input
  - Bit rate: 34.368 Mbps +/–20 ppm
  - Line code: HDB-3
  - Termination: Unbalanced coaxial cable
  - Input impedance: 75 ohms +/–5 percent
  - Cable loss: Up to 12 dB at 17184 kHz (for cable length, see the specification of the cable that you are using)
  - AIS: ITU-T G.704 compliant
- E3-12 output
  - Bit rate: 34.368 Mbps +/– 20 ppm
  - Line code: HDB-3
  - Termination: Unbalanced coaxial cable
  - Output impedance: 75 ohms +/–5 percent
  - AIS: ITU-T G.704 compliant
  - Power level: –1.8 to +5.7 dBm
  - Pulse shape: ITU-T G.703, Figure 17
  - Pulse amplitude: 0.36 to 0.85 V peak-to-peak
  - Loopback modes: Terminal and facility
- E3-12 electrical interface
  - Connectors: 1.0/2.3 miniature coax connectors in the FMEC-E3/DS3 card
- Environmental
  - Overvoltage protection: As in ITU-T G.703 Annex B
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 38.20 W, 0.80 A at –48 V, 130.4 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Depth with backplane connector: 235 mm (9.250 in.)
  - Weight (not including clam shell): 0.7 kg (1.7 lb)

A.5.4 DS3i-N-12 Card Specifications

The DS3i-N-12 card has the following specifications:

- DS3i-N-12 input
  - Bit rate: 44.736 Mbps +/–20 ppm
  - Frame format: ITU-T G.704, ITU-T G.752/DS-3 ANSI T1.107-1988
  - Line code: B3ZS
  - Termination: Unbalanced coaxial cable
  - Input impedance: 75 ohms +/– 5 percent
  - Cable loss:

    Maximum 137 m (450 ft): 734A, RG59, 728A

    Maximum 24 m (79 ft): RG179
  - AIS: ITU-T G.704 compliant
- DS3i-N-12 output
  - Bit rate: 44.736 Mbps +/– 20 ppm
  - Frame format: ITU-T G.704, ITU-T G.752/DS-3 ANSI T1.107-1988
  - Line code: B3ZS
  - Termination: Unbalanced coaxial cable
  - Output impedance: 75 ohms +/–5 percent
  - AIS: ITU-T G.704 compliant
  - Power level: –1.8 to +5.7 dBm

    Note The power level is for a signal of all ones and is measured at a center frequency of 22.368 MHz (3 +/– 1 kHz) bandwidth.

  - Pulse shape: ITU-T G.703, Figure 14/ANSI T1.102-1988, Figure 8
  - Pulse amplitude: 0.36 to 0.85 V peak-to-peak
  - Loopback modes: Terminal and facility
  - Line build out: 0 to 69 m (0 to 225 ft); 69 to 137 m (226 to 450 ft)
- DS3i-N-12 electrical interface
  - Connectors: 1.0/2.3 miniature coax connectors through the FMEC-E3/DS3 card
- Environmental
  - Overvoltage protection: As in ITU-T G.703 Annex B
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 26.80 W, 0.56 A at –48 V, 91.5 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)

  - Depth: 228.6 mm (9.000 in.)
  - Depth with backplane connector: 235 mm (9.250 in.)
  - Weight (not including clam shell): 0.8 kg (1.9 lb)

A.5.5 STM1E-12 Card Specifications

The STM1E-12 card has the following specifications:

- STM1E-12 input
  - Bit rate: 155.52 Mbps +/–5 ppm for STM-1 or 139.264 Mbps +/–15 ppm for E-4
  - Line code: Coded mark inversion (CMI)
  - E-4 (can be framed or unframed)
  - Termination: Unbalanced coaxial cable
  - Input impedance: 75 ohms +/–5 percent
  - Cable loss: Up to 12.7 dB at 78 MHz (for cable length, see the specification of the cable that you are using)
  - AIS: ITU-T G.704 compliant
- STM1E-12 output
  - Bit rate: 155.52 Mbps +/–5 ppm for STM-1 or 139.264 Mbps +/–15 ppm for E-4
  - Line code: CMI
  - E-4 can be framed or unframed
  - Termination: Unbalanced coaxial cable
  - Output impedance: 75 ohms +/–5 percent
  - AIS: ITU-T G.704 compliant
  - Pulse shape: ITU-T G.703, Figure 18 and 19 for E-4, Figure 22 and 23 for STM-1
  - Pulse amplitude: 1 V +/– 0.1 V peak-to-peak
  - Loopback modes: Terminal and facility
- STM1E-12 electrical interface
  - Connectors: 1.0/2.3 miniature coax connectors in the FMEC STM1E 1:1 card
- Environmental
  - Overvoltage protection: As in ITU-T G.703 Annex B
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 59.40 W, 1.24 A at –48 V, 202.8 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)

  - Depth with backplane connector: 235 mm (9.250 in.)
  - Weight (not including clam shell): 0.7 kg (1.7 lb)

A.5.6 FILLER Card

The FILLER card has the following specifications:

- Environmental
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: Not applicable
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Weight (not including clam shell): 0.2 kg (0.4 lb)

A.5.7 FMEC-E1 Specifications

The FMEC-E1 has the following specifications:

- FMEC-E1 input
  - Bit rate: 2.048 Mbps +/–50 ppm
  - Line code: HDB-3
  - Termination: Unbalanced coaxial cable
  - Input impedance: 75 ohms +/–5 percent
  - Cable loss: Up to 6 dB at 1024 kHz
- FMEC-E1 output
  - Bit rate: 2.048 Mbps +/–50 ppm
  - Line code: HDB-3
  - Termination: Unbalanced coaxial cable
  - Output impedance: 75 ohms +/–5 percent
  - Pulse shape: conforms to ITU-T Recommendation G.703 (1991), Section 6.2, Figure 15 and Table 7
  - Pulse amplitude: conforms to ITU-T Recommendation G.703 (1991), Section 6.2, Figure 15 and Table 7
- FMEC-E1 electrical interface
  - Connectors: 1.0/2.3 miniature coax connectors
- Environmental
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 0.00 W, 0.00 A at –48 V, 0.0 BTU/hr

- Dimensions
  - Height: 182 mm (7.165 in.)
  - Width: 32 mm (1.25 in.)
  - Depth: 92 mm (3.62 in.)
  - Depth with backplane connector: 98 mm (3.87 in.)
  - Weight (not including clam shell): 0.3 kg (0.7 lb)

A.5.8 FMEC-DS1/E1 Specifications

The FMEC-DS1/E1 has the following specifications:

- FMEC-DS1/E1 input
  - Bit rate: 2.048 Mbps +/–50 ppm
  - Line code: HDB-3
  - Termination: Balanced twisted-pair cable
  - Input impedance: 120 ohms +/–5 percent
  - Cable loss: Up to 6 dB at 1024 kHz
- FMEC-DS1/E1 output
  - Bit rate: 2.048 Mbps +/–50 ppm
  - Line code: HDB-3
  - Termination: Balanced twisted-pair cable
  - Output impedance: 120 ohms +/–5 percent
  - Pulse shape: conforms to ITU-T Recommendation G.703 (1991), Section 6.2, Figure 15 and Table 7
  - Pulse amplitude: conforms to ITU-T Recommendation G.703 (1991), Section 6.2, Figure 15 and Table 7
- FMEC-DS1/E1 electrical interface
  - Connectors: 37-pin DB connectors
- Environmental
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 0.00 W, 0.00 A at –48 V, 0.0 BTU/hr
- Dimensions
  - Height: 182 mm (7.165 in.)
  - Width: 32 mm (1.25 in.)
  - Depth: 92 mm (3.62 in.)
  - Depth with backplane connector: 98 mm (3.87 in.)
  - Weight (not including clam shell): 0.3 kg (0.6 lb)

A.5.9 FMEC E1-120NP Specifications

The FMEC E1-120NP has the following specifications:

- FMEC E1-120NP input
  - Bit rate: 2.048 Mbps +/–50 ppm
  - Line code: HDB-3
  - Termination: Balanced twisted-pair cable
  - Input impedance: 120 ohms +/–5 percent
  - Cable loss: Up to 6 dB at 1024 kHz
- FMEC E1-120NP output
  - Bit rate: 2.048 Mbps +/–50 ppm
  - Line code: HDB-3
  - Termination: Balanced twisted-pair cable
  - Input impedance: 120 ohms +/–5 percent
  - Pulse shape: conforms to ITU-T Recommendation G.703 (1991), Section 6.2, Figure 15 and Table 7
  - Pulse amplitude: conforms to ITU-T Recommendation G.703 (1991), Section 6.2, Figure 15 and Table 7
- FMEC E1-120NP electrical interface
  - Connectors: Molex 96-pin LFH connectors (21 ports per connector)
- Environmental
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 0.00 W, 0.00 A at –48 V, 0.0 BTU/hr
- Dimensions
  - Height: 182 mm (7.165 in.)
  - Width: 32 mm (1.25 in.)
  - Depth: 92 mm (3.62 in.)
  - Depth with backplane connector: 98 mm (3.87 in.)
  - Weight (not including clam shell): 0.3 kg (0.7 lb)

A.5.10 FMEC E1-120PROA Specifications

The FMEC E1-120PROA has the following specifications:

- FMEC E1-120PROA input
  - Bit rate: 2.048 Mbps +/–50 ppm
  - Line code: HDB-3
  - Termination: Balanced twisted-pair cable
  - Input impedance: 120 ohms +/–5 percent

  - Cable loss: Up to 6 dB at 1024 kHz
- FMEC E1-120PROA output
  - Bit rate: 2.048 Mbps +/–50 ppm
  - Line code: HDB-3
  - Termination: Balanced twisted-pair cable
  - Input impedance: 120 ohms +/–5 percent
  - Pulse shape: conforms to ITU-T Recommendation G.703 (1991), Section 6.2, Figure 15 and Table 7
  - Pulse amplitude: conforms to ITU-T Recommendation G.703 (1991), Section 6.2, Figure 15 and Table 7
- FMEC E1-120PROA electrical interface
  - Connectors: Molex 96-pin LFH connectors (21 ports per connector)
- Environmental
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 0.1 W (provided by the E1-42 card), 0.34 BTU/hr
- Dimensions
  - Height: 182 mm (7.165 in.)
  - Width: 32 mm (1.25 in.)
  - Depth: 92 mm (3.62 in.)
  - Depth with backplane connector: 98 mm (3.87 in.)
  - Weight (not including clam shell): 0.3 kg (0.7 lb)

A.5.11 FMEC E1-120PROB Specifications

The FMEC E1-120PROB has the following specifications:

- FMEC E1-120PROB input
  - Bit rate: 2.048 Mbps +/–50 ppm
  - Line code: HDB-3
  - Termination: Balanced twisted-pair cable
  - Input impedance: 120 ohms +/–5 percent
  - Cable loss: Up to 6 dB at 1024 kHz
- FMEC E1-120PROB output
  - Bit rate: 2.048 Mbps +/–50 ppm
  - Line code: HDB-3
  - Termination: Balanced twisted-pair cable
  - Input impedance: 120 ohms +/–5 percent
  - Pulse shape: conforms to ITU-T Recommendation G.703 (1991), Section 6.2, Figure 15 and Table 7

  - Pulse amplitude: conforms to ITU-T Recommendation G.703 (1991), Section 6.2, Figure 15 and Table 7
- FMEC E1-120PROB electrical interface
  - Connectors: Molex 96-pin LFH connectors (21 ports per connector)
- Environmental
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 0.1 W (provided by the E1-42 card), 0.34 BTU/hr
- Dimensions
  - Height: 182 mm (7.165 in.)
  - Width: 32 mm (1.25 in.)
  - Depth: 92 mm (3.62 in.)
  - Depth with backplane connector: 98 mm (3.87 in.)
  - Weight (not including clam shell): 0.3 kg (0.7 lb)

A.5.12 E1-75/120 Impedance Conversion Panel Specifications

The FMEC E1-75/120 impedance conversion panel has the following specifications:

- E1-75/120 input
  - Bit rate: 2.048 Mbps +/–50 ppm
  - Line code: HDB-3
- E1-75/120 output
  - Bit rate: 2.048 Mbps +/–50 ppm
  - Line code: HDB-3
- E1-75/120 electrical interface
  - Connectors:

    1.0/2.3 miniature coax connectors on 75-ohm side

    Molex 96-pin LFH connectors on 120-ohm side
  - Impedance tolerance: +/–5 percent
- Environmental
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: Not applicable; the E1-75/120 is a passive device.
- Dimensions
  - Height: 75 mm (2.95 in.)
  - Width: 535 mm (21.06 in.)
  - Depth: 221 mm (8.7 in.)
  - Weight (not including clam shell): 2.15 kg (4.74 lb)

A.5.13 FMEC-E3/DS3 Specifications

The FMEC-E3/DS3 has the following specifications:

- FMEC-E3/DS3 input (for E3 signals)
  - Bit rate: 34.368 Mbps +/–20 ppm
  - Line code: HDB-3
  - Termination: Unbalanced coaxial cable
  - Input impedance: 75 ohms +/–5 percent
  - Cable loss: Up to 12 dB at 17184 kHz
- FMEC-E3/DS3 output (for E3 signals)
  - Bit rate: 34.368 Mbps +/–20 ppm
  - Line code: HDB-3
  - Termination: Unbalanced coaxial cable
  - Output impedance: 75 ohms +/–5 percent
  - Pulse shape: ITU-T G.703, Figure 17
  - Pulse amplitude: ITU-T G.703, Figure 17 and Table 9
- FMEC-E3/DS3 Input (for DS3 signals)
  - Bit rate: 44.736 Mbps +/– 20 ppm
  - Line code: B3ZS
  - Termination: Unbalanced coaxial cable
  - Input impedance: 75 ohms +/–5 percent
  - Cable loss:

    Maximum 137 m (450 ft): 734A, RG59, 728A

    Max 24 m (79 ft): RG179
- FMEC-E3/DS3 output (for DS3 signals)
  - Bit rate: 44.736 Mbps +/–20 ppm
  - Line code: B3ZS
  - Termination: Unbalanced coaxial cable
  - Output impedance: 75 ohms +/–5 percent
  - AIS: TR-TSY-000191 compliant
  - Power level: ITU-T G.703, Table 6; –1.8 to +5.7 dBm
  - Pulse shape: ITU-T G.703, Table 6 and Figure 14; ANSI T1.102-1988, Figure 8
  - Pulse amplitude: ITU-T G.703, Table 6; 0.36 to 0.85 V peak-to-peak
  - Line build out: 0 to 68.58 m (0 to 225 ft.); 68.88 to 137.16 m (226 to 450 ft.)
- FMEC-E3/DS3 electrical interface
  - Connectors: 1.0/2.3 miniature coax connectors
- Environmental
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)

  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 0.00 W, 0.00 A at –48 V, 0.0 BTU/hr
- Dimensions
  - Height: 182 mm (7.165 in.)
  - Width: 32 mm (1.25 in.)
  - Depth: 92 mm (3.62 in.)
  - Depth with backplane connector: 98 mm (3.87 in.)
  - Weight (not including clam shell): 0.3 kg (0.7 lb)

A.5.14 FMEC STM1E 1:1 Specifications

The FMEC STM1E 1:1 has the following specifications:

- FMEC STM1E 1:1 input
  - Bit rate: 155.52 Mbps +/–20 ppm
  - Line code: CMI
  - Termination: Unbalanced coaxial cable
  - Input impedance: 75 ohms +/–5 percent
  - Cable loss: Up to 12.7 dB at 78 MHz
- FMEC STM1E 1:1 E4 input
  - Bit rate: 139.264 Mbps +/–15 ppm
  - Line code: CMI
  - Termination: Unbalanced coaxial cable
  - Input impedance: 75 ohms +/–5 percent
  - Cable loss: Up to 12.7 dB at 78 MHz
- FMEC STM1E 1:1 output
  - Bit rate: 155.52 Mbps +/–20 ppm
  - Line code: CMI
  - Termination: Unbalanced coaxial cable
  - Output impedance: 75 ohms +/–5 percent
  - Pulse shape: ITU-T G.703, Figure 18 and 19 for E-4, Figure 22 and 23 for STM-1
  - Pulse amplitude: 1 V +/– 0.1 V peak-to-peak
- FMEC STM1E E4 output
  - Bit rate: 139.264 Mbps +/–20 ppm
  - Line code: CMI
  - Termination: Unbalanced coaxial cable
  - Output impedance: 75 ohms +/–5 percent
  - Pulse shape: ITU-T G.703, Figure 18 and 19 for E-4, Figure 22 and 23 for STM-1
  - Pulse amplitude: 1 V +/– 0.1 V peak-to-peak

- FMEC STM1E 1:1 electrical interface
  - Connectors: 1.0/2.3 miniature coax connectors
- Environmental
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 8.8 W (provided by the STM1E-12 card), 30.0 BTU/hr
- Dimensions
  - Height: 182 mm (7.165 in.)
  - Width: 32 mm (1.25 in.)
  - Depth: 92 mm (3.62 in.)
  - Depth with backplane connector: 98 mm (3.87 in.)
  - Weight (not including clam shell): 0.3 kg (0.7 lb)

A.5.15 BLANK-FMEC Specifications

The BLANK-FMEC is a sheet metal plate that is used to cover up empty FMEC slots. It has the following specifications:

- Environmental
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: Not applicable
- Dimensions
  - Height: 182 mm (7.165 in.)
  - Width: 32 mm (1.25 in.)
  - Weight (not including clam shell): 0.2 kg (0.4 lb)

A.5.16 MIC-A/P Specifications

The MIC-A/P FMEC has the following specifications:

- Power supply input BATTERY B
  - System supply voltage:

    Nominal –48 VDC

    Tolerance limits: –40.5 to –57.0 VDC
  - Connector: 3WK3 Combo-D power cable connector
- Alarm outputs
  - Voltage (open contact): Maximum 60 VDC
  - Current (closed contact): Maximum 250 mA
  - Connector: 62-pin DB connector (common for inputs/outputs)

- Alarm inputs
  - Voltage (open contact): Maximum 60 VDC
  - Current (closed contact): Maximum 2 mA
  - Connector: 62-pin DB connector (common for inputs/outputs)
- Environmental
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 0.13 W (provided by +5 V from the TCC2/TCC2P card), 0.44 BTU/hr
- Dimensions
  - Height: 182 mm (7.165 in.)
  - Width: 32 mm (1.25 in.)
  - Depth: 92 mm (3.62 in.)
  - Depth with backplane connector: 98 mm (3.87 in.)
  - Weight (not including clam shell): 0.2 kg (0.5 lb)

A.5.17 MIC-C/T/P Specifications

The MIC-C/T/P FMEC has the following specifications:

- Power supply input BATTERY A
  - System supply voltage:

    Nominal –48 VDC

    Tolerance limits: –40.5 to –57.0 VDC
  - Connector: 3WK3 Combo-D power cable connector
- Timing connector
  - Frequency: 2.048 MHz +/–10 ppm
  - Signal level: 0.75 to 1.5 V
  - Impedance: 75 ohms +/–5 percent (switchable by jumper to high impedance > 3 kohms)

    Note 120 ohms balanced impedance is possible with external matching cable.
  - Cable attenuation: Up to 6 dB at 2 MHz
  - Connectors: 1.0/2.3 miniature coax connector
- System management serial port:
  - System management serial port craft interface
  - Modem port (for future use)
  - Connectors: 8-pin RJ-45
- System management LAN port connectors:
  - Signal: IEEE 802.3 10BaseT

  - Connectors: 8-pin RJ-45
- Environmental
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 0.38 W (provided by +5 V from the TCC2/TCC2P card), 1.37 BTU/hr
- Dimensions
  - Height: 182 mm (7.165 in.)
  - Width: 32 mm (1.25 in.)
  - Depth: 92 mm (3.62 in.)
  - Depth with backplane connector: 98 mm (3.87 in.)
  - Weight (not including clam shell): 0.2 kg (0.5 lb)

A.6 Optical Card Specifications

This section provides specifications for the optical cards.

For compliance information, refer to the *Cisco Optical Transport Products Safety and Compliance Information* document.

A.6.1 OC3 IR 4/STM1 SH 1310 Card Specifications

The OC3 IR 4/STM1 SH 1310 card has the following specifications:

- Line
  - Bit rate: 155.52 Mbps
  - Code: Scrambled non-return to zero (NRZ)
  - Fiber: 1310-nm single-mode
  - Loopback modes: Terminal and facility
  - Connector: SC
  - Compliance: ITU-T G.707, ITU-T G.957
- Transmitter
  - Maximum transmitter output power: –8 dBm
  - Minimum transmitter output power: –15 dBm
  - Center wavelength: 1261 to 1360 nm
  - Nominal wavelength: 1310 nm
  - Transmitter: Fabry Perot laser
  - Extinction ratio: 8.2 dB
  - Dispersion ratio: 96 ps/nm
- Receiver
  - Maximum receiver level: –8 dBm at BER 1 * 10 exp – 12

  - Minimum receiver level: –28 dBm at BER 1 * 10 exp – 12
  - Receiver: InGaAs/InP photodetector
  - Link loss budget: 13 dB
  - Receiver input wavelength range: 1261 to 1360 nm
  - Jitter tolerance: Telcordia GR-253/ITU-T G.823 compliant
- Environmental
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 19.20 W, 0.40 A at –48 V, 65.56 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Depth with backplane connector: 235 mm (9.250 in.)
  - Weight (not including clam shell): 0.4 kg (1.0 lb)

A.6.2 OC3 IR/STM1 SH 1310-8 Card Specifications

The OC3IR/STM1 SH 1310-8 card has the following specifications:

- Line
  - Bit rate: 155.52 Mbps
  - Code: Scrambled NRZ
  - Fiber: 1310-nm single-mode
  - Loopback modes: Terminal and facility
  - Connector: LC
  - Compliance: ITU-T G.707, ITU-T G.957
- Transmitter
  - Maximum transmitter output power: –8 dBm
  - Minimum transmitter output power: –15 dBm
  - Center wavelength: 1293 to 1334 nm
  - Nominal wavelength: 1310 nm
  - Transmitter: Fabry Perot laser
  - Extinction ratio: 8.2 dB
  - Dispersion tolerance: 96 ps/nm
- Receiver
  - Maximum receiver level: –8 dBm at BER 1 * 10 exp – 12
  - Minimum receiver level: –28 dBm at BER 1 * 10 exp – 12
  - Receiver: InGaAs/InP photodetector

  - Link loss budget: 13 dB
  - Receiver input wavelength range: 1274 to 1356 nm
  - Jitter tolerance: Telcordia GR-253/ITU-T G.823 compliant
- Environmental
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 23.00 W, 0.48 A at –48 V, 78.5 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Depth with backplane connector: 235 mm (9.250 in.)
  - Weight (not including clam shell): 0.4 kg (1.0 lb)

A.6.3 OC12 IR/STM4 SH 1310 Card Specifications

The OC12 IR/STM4 SH 1310 card has the following specifications:

- Line
  - Bit rate: 622.08 Mbps
  - Code: Scrambled NRZ
  - Fiber: 1310-nm single-mode
  - Loopback modes: Terminal and facility
  - Connectors: SC
  - Compliance: ITU-T G.707, ITU-T G.957
- Transmitter
  - Maximum transmitter output power: –8 dBm
  - Minimum transmitter output power: –15 dBm
  - Center wavelength: 1274 to 1356 nm
  - Nominal wavelength: 1310 nm
  - Transmitter: Fabry Perot laser
  - Extinction ratio: 8.2 dB
  - Dispersion tolerance: 96 ps/nm
- Receiver
  - Maximum receiver level: –8 dBm at BER 1 * 10 exp – 12
  - Minimum receiver level: –28 dBm at BER 1 * 10 exp – 12
  - Receiver: InGaAs/InP photodetector
  - Link loss budget: 13 dB
  - Receiver input wavelength range: 1274 to 1356 nm

  - Jitter tolerance: Telcordia GR-253/ITU-T G.823 compliant
- Environmental
  - Operating temperature: –5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 10.90 W, 0.23 A at –48 V, 37.2 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Depth with backplane connector: 235 mm (9.250 in.)
  - Weight (not including clam shell): 0.6 kg (1.4 lb)

A.6.4 OC12 LR/STM4 LH 1310 Card Specifications

The OC12 LR/STM4 LH 1310 card has the following specifications:

- Line
  - Bit rate: 622.08 Mbps
  - Code: Scrambled NRZ
  - Fiber: 1310-nm single-mode
  - Loopback modes: Terminal and facility
  - Connectors: SC
  - Compliance: ITU-T G.707, ITU-T G.957
- Transmitter
  - Maximum transmitter output power: +2 dBm
  - Minimum transmitter output power: –3 dBm
  - Center wavelength: 1280 to 1335 nm
  - Nominal wavelength: 1310 nm
  - Transmitter: Distributed feedback (DFB) laser
- Receiver
  - Maximum receiver level: –8 dBm at BER 1 * 10 exp – 12
  - Minimum receiver level: –28 dBm at BER 1 * 10 exp – 12
  - Receiver: InGaAs/InP photodetector
  - Link loss budget: 25 dB
  - Receiver input wavelength range: 1280 to 1335 nm
- Environmental
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 9.28 W, 0.19 A at –48 V, 31.7 BTU/hr

- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Depth with backplane connector: 235 mm (9.250 in.)
  - Weight (not including clam shell): 0.6 kg (1.4 lb)

A.6.5 OC12 LR/STM4 LH 1550 Card Specifications

The OC12 LR/STM4 LH 1550 card has the following specifications:

- Line
  - Bit rate: 622.08 Mbps
  - Code: Scrambled NRZ
  - Fiber: 1550-nm single-mode
  - Loopback modes: Terminal and facility
  - Connectors: SC
  - Compliance: ITU-T G.707, ITU-T G.957
- Transmitter
  - Maximum transmitter output power: +2 dBm
  - Minimum transmitter output power: –3 dBm
  - Center wavelength: 1480 to 1580 nm
  - Nominal wavelength: 1550 nm
  - Transmitter: DFB laser
- Receiver
  - Maximum receiver level: –8 dBm at BER 1 * 10 exp – 12
  - Minimum receiver level: –28 dBm at BER 1 * 10 exp – 12
  - Receiver: InGaAs/InP photodetector
  - Link loss budget: 25 dB
  - Receiver input wavelength range: 1480 to 1580 nm
- Environmental
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 9.28 W, 0.19 A at –48 V, 31.7 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Depth with backplane connector: 235 mm (9.250 in.)

  - Weight (not including clam shell): 0.6 kg (1.4 lb)

A.6.6 OC12 IR/STM4 SH 1310-4 Card Specifications

The OC12 IR/STM4 SH 1310-4 card has the following specifications:

- Line
  - Bit rate: 622.08 Mbps
  - Code: Scrambled NRZ
  - Fiber: 1310-nm single-mode
  - Chromatic dispersion allowance: 74 ps/nm for the spectral range of 1274 to1356 nm; 46 ps/nm for the spectral range of 1293 to1334 nm
  - Loopback modes: Terminal and facility
  - Connector: SC
- Transmitter
  - Maximum transmitter output power: –8 dBm
  - Minimum transmitter output power: –15 dBm
  - Center wavelength: 1293 to 1334 nm
  - Nominal wavelength: 1310 nm
  - Transmitter: Fabry Perot laser
- Receiver
  - Maximum receiver level: –8 dBm at BER 1 * 10 exp – 10
  - Minimum receiver level: –30 dBm at BER 1 * 10 exp – 10
  - Receiver: InGaAs/InP photodetector
  - Link loss budget: 15 dB
  - Receiver input wavelength range: 1274 to 1356 nm
- Environmental
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 28 W, 0.58 A at –48 V, 95.6 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Depth with backplane connector: 235 mm (9.250 in.)
  - Weight (not including clam shell): 0.4 kg (1.0 lb)

A.6.7 OC48 IR/STM16 SH AS 1310 Card Specifications

The OC48 IR/STM16 SH AS 1310 card has the following specifications:

- Line
  - Bit rate: 2488.320 Mbps
  - Code: Scrambled NRZ
  - Fiber: 1310-nm single-mode
  - Loopback modes: Terminal and facility
  - Connectors: SC
  - Compliance: ITU-T G.707, ITU-T G.957
- Transmitter
  - Maximum transmitter output power: 0 dBm
  - Minimum transmitter output power: –5 dBm
  - Center wavelength: 1280 to 1350 nm
  - Nominal wavelength: 1310 nm
  - Transmitter: DFB laser
- Receiver
  - Maximum receiver level: 0 dBm at BER 1 * 10 exp – 10
  - Minimum receiver level: –18 dBm at BER 1 * 10 exp – 10
  - Receiver: InGaAs InP photodetector
  - Link loss budget: 13 dB minimum
  - Receiver input wavelength range: 1280 to 1350 nm
- Environmental
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 37.20 W, 0.78 A at –48 V, 127.0 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Depth with backplane connector: 235 mm (9.250 in.)
  - Weight (not including clam shell): 0.9 kg (2.2 lb)

A.6.8 OC48 LR/STM16 LH AS 1550 Card Specifications

The OC48 LR/STM16 LH AS 1550 card has the following specifications:

- Line
  - Bit rate: 2488.320 Mbps

  - Code: Scrambled NRZ
  - Fiber: 1550-nm single-mode
  - Loopback modes: Terminal and facility
  - Connectors: SC
  - Compliance: ITU-T G.707, ITU-T G.957
- Transmitter
  - Maximum transmitter output power: +3 dBm
  - Minimum transmitter output power: –2 dBm
  - Center wavelength: 1520 to 1580 nm
  - Nominal wavelength: 1550 nm
  - Transmitter: DFB laser
- Receiver
  - Maximum receiver level: –8 dBm at BER 1 * 10 exp – 10
  - Minimum receiver level: –28 dBm at BER 1 * 10 exp – 10
  - Receiver: InGaAs avalanche photo diode (APD) photodetector
  - Link loss budget: 26 dB minimum, with 1 dB dispersion penalty
  - Receiver input wavelength range: 1520 to 1580 nm
- Environmental
  - Eye safety compliance: Class 1 (EN60825)
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 37.20 W, 0.78 A at –48 V, 127.0 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Depth with backplane connector: 235 mm (9.250 in.)
  - Weight (not including clam shell): 0.9 kg (2.2 lb)

A.6.9 OC48 ELR/STM16 EH 100 GHz Card Specifications

The OC48 ELR/STM16 EH 100 GHz cards have the following specifications:

- Line
  - Bit rate: 2488.320 Mbps
  - Code: Scrambled NRZ
  - Fiber: 1550-nm single-mode
  - Loopback modes: Terminal and facility
  - Connectors: SC

  - Compliance: ITU-T G.692, ITU-T G.707, ITU-T G.957, ITU-T G.958
- Transmitter
  - Maximum transmitter output power: 0 dBm
  - Minimum transmitter output power: –2 dBm
  - Center wavelength: +/– 0.25 nm
  - Transmitter: DFB laser
- Receiver
  - Maximum receiver level: –8 dBm at BER 1 * 10 exp – 10
  - Minimum receiver level: –28 dBm at BER 1 * 10 exp – 10
  - Receiver: InGaAs APD photodetector
  - Link loss budget: 26 dB minimum, with 1 dB dispersion penalty
  - Receiver input wavelength range: 1520 to 1580 nm
- Environmental
  - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 31.20 W, 0.65 A at –48 V, 106.5 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Depth with backplane connector: 235 mm (9.250 in.)
  - Weight (not including clam shell): 1.1 kg (2.4 lb)
- Currently available wavelengths and versions of the OC48 ELR/STM16 EH 100 GHz card:

  ITU grid blue band (2 * 100 GHz spacing):
  - 1530.33 +/– 0.25 nm, STM-16HS-LH 1530.33 (DWDM)
  - 1531.90 +/– 0.25 nm, STM-16HS-LH 1531.90 (DWDM)
  - 1533.47 +/– 0.25 nm, STM-16HS-LH 1533.47 (DWDM)
  - 1535.04 +/– 0.25 nm, STM-16HS-LH 1535.04 (DWDM)
  - 1536.61 +/– 0.25 nm, STM-16HS-LH 1536.61 (DWDM)
  - 1538.19 +/– 0.25 nm, STM-16HS-LH 1538.19 (DWDM)
  - 1539.77 +/– 0.25 nm, STM-16HS-LH 1539.77 (DWDM)
  - 1541.35 +/– 0.25 nm, STM-16HS-LH 1541.35 (DWDM)
  - 1542.94 +/– 0.25 nm, STM-16HS-LH 1542.94 (DWDM)

  ITU grid red band (2 * 100 GHz spacing):
  - 1547.72 +/– 0.25 nm, STM-16HS-LH 1547.72 (DWDM)
  - 1549.32 +/– 0.25 nm, STM-16HS-LH 1549.32 (DWDM)
  - 1550.92 +/– 0.25 nm, STM-16HS-LH 1550.92 (DWDM)
  - 1552.52 +/– 0.25 nm, STM-16HS-LH 1552.52 (DWDM)

  - 1554.13 +/– 0.25 nm, STM-16HS-LH 1554.13 (DWDM)
  - 1555.75 +/– 0.25 nm, STM-16HS-LH 1555.75 (DWDM)
  - 1557.36 +/– 0.25 nm, STM-16HS-LH 1557.36 (DWDM)
  - 1558.98 +/– 0.25 nm, STM-16HS-LH 1558.98 (DWDM)
  - 1560.61 +/– 0.25 nm, STM-16HS-LH 1560.61 (DWDM)

A.6.10 OC192 SR/STM64 IO 1310 Card Specifications

The OC192 SR/STM64 IO 1310 card has the following specifications:

- Line
  - Bit rate: 9.95328 Gbps
  - Code: Scrambled NRZ
  - Fiber: 1310-nm single-mode
  - Maximum chromatic dispersion allowance: 6.6 ps/nm
  - Loopback modes: Terminal and facility
  - Connectors: SC
  - Compliance: ITU-T G.707, ITU-T G.957, ITU-T G.691
- Transmitter
  - Maximum transmitter output power: –1 dBm
  - Minimum transmitter output power: –6 dBm
  - Center wavelength: 1290 to 1330 nm
  - Nominal wavelength: 1310 nm
  - Transmitter: Directly modulated laser
- Receiver
  - Maximum receiver level: –1 dBm at BER 1 * 10 exp – 12
  - Minimum receiver level: –11 dBm at BER 1 * 10 exp – 12
  - Receiver: PIN diode
  - Link loss budget: 5 dB minimum, plus 1 dB dispersion penalty at BER = 1 * 10 exp – 12 including dispersion
  - Receiver input wavelength range: 1290 to 1330 nm
- Environmental
  - Operating temperature: –5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 47.00 W, 0.98 A at –48 V, 160.5 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)

- Depth with backplane connector: 235 mm (9.250 in.)
- Weight (not including clam shell): 1.3 kg (3.1 lb)

A.6.11 OC192 IR/STM64 SH 1550 Card Specifications

The OC192 IR/STM64 SH 1550 card has the following specifications:

- Line
  - Bit rate: 9.95328 Gbps
  - Code: Scrambled NRZ
  - Fiber: 1550-nm single-mode
  - Maximum chromatic dispersion allowance: 800 ps/nm
  - Loopback modes: Terminal and facility

Note You must use a 3 to 15 dB fiber attenuator (5 dB recommended) when working with the OC192 IR/STM64 SH 1550 card in a loopback. Do not use fiber loopbacks with the OC192 IR/STM64 SH 1550 card. Using fiber loopbacks can cause irreparable damage to the OC192 IR/STM64 SH 1550 card.

  - Connectors: SC
  - Compliance: ITU-T G.707, ITU-T G.957
- Transmitter
  - Maximum transmitter output power: +2 dBm
  - Minimum transmitter output power: –1 dBm
  - Center wavelength: 1530 to 1565 nm
  - Nominal wavelength: 1550 nm
  - Transmitter: Cooled European accreditation (EA) modulated laser
- Receiver
  - Maximum receiver level: –1 dBm at BER 1 * 10 exp – 12
  - Minimum receiver level: –14 dBm at BER 1 * 10 exp – 12
  - Receiver: Positive-intrinsic-negative (PIN) diode
  - Link loss budget: 13 dB minimum, plus 2 dB dispersion penalty at BER = 1 * 10 exp – 12 including dispersion
  - Receiver input wavelength range: 1530 to 1565 nm
- Environmental
  - Operating temperature: –5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 50.00 W, 1.04 A at –48 V, 170.7 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)

- Width: 18.2 mm (0.716 in.)
- Depth: 228.6 mm (9.000 in.)
- Depth with backplane connector: 235 mm (9.250 in.)
- Weight (not including clam shell): 1.3 kg (3.1 lb)

A.6.12 OC192 LR/STM64 LH 1550 Card Specifications

The OC192 LR/STM64 LH 1550 card has the following specifications:

- Line
  - Bit rate: 9.95328 Gbps
  - Code: Scrambled NRZ
  - Fiber: 1550-nm single-mode
  - Maximum chromatic dispersion allowance: 1360 ps/nm

Caution You must use a 20 dB fiber attenuator (19 to 24 dB) when working with the OC192 LR/STM64 LH 1550 card in a loopback. Do not use fiber loopbacks with these cards.

  - Loopback modes: Terminal and facility
  - Connectors: SC
  - Compliance: ITU-T G.707, ITU-T G.957
- Transmitter
  - Maximum transmitter output power: +10 dBm
  - Minimum transmitter output power: +7 dBm
  - Center wavelength: 1545 to 1555 nm
  - Nominal wavelength: 1550 nm
  - Transmitter: Lithium Niobate (LN) external modulator transmitter
- Receiver
  - Maximum receiver level: –9 dBm at BER 1 * 10 exp – 12
  - Minimum receiver level: –21 dBm at BER 1 * 10 exp – 12
  - Receiver: APD/TIA
  - Link loss budget: 24 dB minimum, with no dispersion or 22 dB optical path loss at BER = 1 * 10 exp – 12 including dispersion
  - Receiver input wavelength range: 1545 to 1555 nm
- Environmental
  - Operating temperature: –5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 72.20 W, 1.50 A at –48 V, 246.5 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)

- Width: 18.2 mm (0.716 in.)
- Depth: 228.6 mm (9.000 in.)
- Depth with backplane connector: 235 mm (9.250 in.)
- Weight (not including clam shell): 1.3 kg (3.1 lb)

A.6.13 OC192 LR/STM64 LH ITU 15xx.xx Card Specifications

The OC192 LR/STM64 LH ITU 15xx.xx card has the following specifications:

- Line
  - Bit rate: 9.95328 Gbps
  - Code: Scrambled NRZ
  - Fiber: 1550-nm single-mode
  - Maximum chromatic dispersion allowance:

    In deployments with a dispersion compensating unit (DCU): +/– 1000 ps/nm, with optical signal-to-noise ratio (OSNR) of 19 dB (0.5 nm resolution bandwidth [RBW])

    In deployments without a DCU: +/– 1200 ps/nm, with OSNR of 23 dB (0.5 nm RBW)
  - Loopback modes: Terminal and facility

  Note You must use a 20-dB fiber attenuator (15 to 25 dB) when working with the OC192 LR/STM64 LH 15xx.xx card in a loopback. Do not use fiber loopbacks with the OC192 LR/STM64 LH 15xx.xx card. Using fiber loopbacks causes irreparable damage to this card.

  - Connectors: SC
  - Compliance: ITU-T G.707, ITU-T G.957
- Transmitter
  - Maximum transmitter output power: +6 dBm
  - Minimum transmitter output power: +3 dBm
  - Center wavelength: See wavelength plan
  - Center wavelength accuracy: +/– 0.040 nm
  - Transmitter: LN external modulator transmitter
- Receiver
  - Maximum receiver level: –9 dBm at BER 1 * 10 exp – 12
  - Minimum receiver level: –22 dBm at BER 1 * 10 exp – 12
  - Receiver: APD
  - Link loss budget: 25 dB minimum, plus 2 dB dispersion penalty at BER = 1 * 10 exp – 12 including dispersion
  - Receiver input wavelength range: 1529 to 1565 nm
- Environmental
  - Operating temperature: –5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)

  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 52.00 W, 1.08 A at –48 V, 177.6 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Depth with backplane connector: 235 mm (9.250 in.)
  - Weight (not including clam shell): 1.3 kg (3.1 lb)
- Currently available wavelengths and versions of OC192 LR/STM64 LH ITU 15xx.xx card:

  ITU grid blue band:
  - 1534.25 +/– 0.040 nm, OC192 LR/STM64 LH ITU 1534.25
  - 1535.04 +/– 0.040 nm, OC192 LR/STM64 LH ITU 1535.04
  - 1535.82 +/– 0.040 nm, OC192 LR/STM64 LH ITU 1535.82
  - 1536.61 +/– 0.040 nm, OC192 LR/STM64 LH ITU 1536.61
  - 1538.19 +/– 0.040 nm, OC192 LR/STM64 LH ITU 1538.19
  - 1538.98 +/– 0.040 nm, OC192 LR/STM64 LH ITU 1538.98
  - 1539.77 +/– 0.040 nm, OC192 LR/STM64 LH ITU 1539.77
  - 1540.56 +/– 0.040 nm, OC192 LR/STM64 LH ITU 1540.56

  ITU grid red band:
  - 1550.12 +/– 0.040 nm, OC192 LR/STM64 LH ITU 1550.12
  - 1550.92 +/– 0.040 nm, OC192 LR/STM64 LH ITU 1550.92
  - 1551.72 +/– 0.040 nm, OC192 LR/STM64 LH ITU 1551.72
  - 1552.52 +/– 0.040 nm, OC192 LR/STM64 LH ITU 1552.52
  - 1554.13 +/– 0.040 nm, OC192 LR/STM64 LH ITU 1554.13
  - 1554.94 +/– 0.040 nm, OC192 LR/STM64 LH ITU 1554.94
  - 1555.75 +/– 0.040 nm, OC192 LR/STM64 LH ITU 1555.75
  - 1556.55 +/– 0.040 nm, OC192 LR/STM64 LH ITU 1556.55

A.6.14 15454_MRC-12 Card Specifications

The 15454_MRC-12 card has the following specifications:

- Line
  - Bit rate: up to STM-16 (2488.320 Mbps), depending on SFP

Note Each optical interface on the card can be configured as STM-1, STM-4, or STM-16, depending on the available backplane bandwidth and existing provisioned lines. In general, the card supports all different rates on the line side as long as the accumulated bandwidth does not exceed the total backplane allowed bandwidth.

  - Fiber: 1550-nm single-mode
  - Connectors: LC duplex connector for each SFP
  - Compliance: ITU-T G.957 and Telcordia GR-253
- Transmitter
  - Maximum transmitter output power: Depends on SFP (see A.2 SFP and XFP Specifications, page A-3)
  - Minimum transmitter output power: Depends on SFP (see A.2 SFP and XFP Specifications, page A-3)
  - Center wavelength: See wavelength plan
  - Center wavelength accuracy: 1 nm to 4 nm, depending on SFP
  - Transmitter: Fabry Perot and DFB laser
- Receiver
  - Maximum receiver level: Depends on SFP (see A.2 SFP and XFP Specifications, page A-3)
  - Minimum receiver level: Depends on SFP (see A.2 SFP and XFP Specifications, page A-3)
  - Receiver: PIN PD
  - Receiver input wavelength range: Depends on SFP
- Environmental
  - Operating temperature: –40 to +55 degrees Celsius (–40 to +149 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 38.00 W, 0.79 A at –48 V, 129.66 BTU/hr
- Dimensions
  - Height: 12.650 in. (321.3 mm)
  - Width: 0.716 in. (18.2 mm)
  - Depth: 9.000 in. (228.6 mm)
  - Depth with backplane connector: 9.250 in. (235 mm)
  - Weight (not including clam shell): 3.1 lb (1.3 kg)
- Wavelength Plan: Currently available wavelengths and versions of the 15454_MRC-12 card:
  - For ONS-SC-2G-30.3 through ONS-SC-2G-60.0 SFPs: 1530.33 nm to 1560.61 nm (32 distinct wavelengths at 100 GHz spacing)
  - For ONS-SE-622-1470 through ONS-SE-622-1610 SFPs: 1470 to 1610 nm (eight distinct wavelengths at 2500 GHz spacing)
  - For ONS_SE-155-1470 through ONS-SE-155-1610 SFPs: 1470 to 1610 nm (eight distinct wavelengths at 2500 GHz spacing)

A.6.15 OC192SR1/STM64IO Short Reach Card Specifications

The OC192SR1/STM64IO Short Reach card has the following specifications:

Note The OC192SR1/STM64IP Short Reach card is designated as OC192-XFP in CTC.

- Line
  - Bit rate: STM-64 (9.9520 Gbps)
  - Fiber: 1310-nm single-mode
  - Connectors: LC duplex connector for the XFP
  - Compliance: ITU G.957 and GR-253
- Transmitter
  - Maximum transmitter output power: –1 dBm
  - Minimum transmitter output power: –6 dBm
- Receiver
  - Maximum receiver level: –1 dBm
  - Minimum receiver level: –11 dBm
  - Receiver input wavelength range: 1260 to 1565 nm
- Environmental
  - Operating temperature: 0 to +55 degrees Celsius (32 to +131 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 40.00 W, 0.83 A at –48 V, 136.49 BTU/hr
- Dimensions
  - Height: 12.650 in. (321.3 mm)
  - Width: 0.716 in. (18.2 mm)
  - Depth: 9.000 in. (228.6 mm)
  - Depth with backplane connector: 9.250 in. (235 mm)
  - Weight (not including clam shell): 3.1 lb (1.3 kg)

A.6.16 OC192/STM64 Any Reach Card Specifications

The OC192/STM64 Any Reach card has the following specifications:

Note The OC192/STM64 Any Reach card is designated as OC192-XFP in CTC.

- Line
  - Bit rate: STM-64 (9.9520 Gbps)
  - Fiber: 1310-nm single-mode for ONS-XC-10G-S1 XFP, 1550-nm single mode for ONS-XC-10G-I2 and ONS-XC-10G-L2 XFPs
  - Connectors: LC duplex connector for the XFPs
  - Compliance: ITU G.957 and GR-253
- Transmitter
  - Maximum transmitter output power: Depends on SFP (see the "A.2 SFP and XFP Specifications" section on page A-3)

  - Minimum transmitter output power: Depends on SFP (see the "A.2 SFP and XFP Specifications" section on page A-3)
- Receiver
  - Maximum receiver level: Depends on SFP (see the "A.2 SFP and XFP Specifications" section on page A-3)
  - Minimum receiver level: Depends on SFP (see the "A.2 SFP and XFP Specifications" section on page A-3)
  - Receiver input wavelength range: 1260 to 1565 nm
- Environmental
  - Operating temperature: 0 to +55 degrees Celsius (32 to +131 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 40.00 W, 0.83 A at –48 V, 136.49 BTU/hr
- Dimensions
  - Height: 12.650 in. (321.3 mm)
  - Width: 0.716 in. (18.2 mm)
  - Depth: 9.000 in. (228.6 mm)
  - Depth with backplane connector: 9.250 in. (235 mm)
  - Weight (not including clam shell): 3.1 lb (1.3 kg)

A.7 Ethernet Card Specifications

This section includes specifications for the Ethernet cards.

For compliance information, refer to the *Cisco Optical Transport Products Safety and Compliance Information* document.

A.7.1 E100T-G Card Specifications

The E100T-G card has the following specifications:

- Environmental
  - Operating temperature:

    C-Temp (15454-E100T-G): 0 to +55 degrees Celsius (32 to 131 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 65 W, 1.35 A, 221.93 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Weight (not including clam shell): 2.3 lb (1.0 kg)
- Compliance

  - ONS 15454 SDH cards, when installed in a system, comply with these safety standards: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950

A.7.2 E1000-2-G Card Specifications

The E1000-2-G card has the following specifications:

- Environmental
  - Operating temperature:

    C-Temp (15454-E1000-2-G): 0 to +55 degrees Celsius (32 to 131 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 53.50 W, 1.11 A, 182.67 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Weight (not including clam shell): 2.1 lb (0.9 kg)
- Compliance
  - ONS 15454 SDH cards, when installed in a system, comply with these safety standards: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950
  - Eye Safety Compliance: Class I (21 CFR 1040.10 and 1040.11) and Class 1M (IEC 60825-1 2001-01) laser products

A.7.3 CE-1000-4 Card Specifications

The CE-1000-4 card has the following specifications:

- Environmental
  - Operating temperature: +23 to +131 degrees Fahrenheit (-5 to +55 degrees Celsius)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 60 W, 1.25 A at -48 V, 204.8 BTU/hr
- Dimensions
  - Height: 12.650 in. (321.310 mm)
  - Width: 0.716 in. (18.2 mm)
  - Depth: 9.000 in. (228.6 mm)
  - Card weight: 2.1 lb (0.9 kg)

A.7.4 CE-100T-8 Card Specifications

The CE-100T-8 card has the following specifications:

- Environmental

  - Operating temperature:

    C-Temp (15454-CE100T): 0 to +55 degrees Celsius (32 to 131 degrees Fahrenheit)
  - Operating humidity: 0 to 95 percent, noncondensing
  - Power consumption: 53 W, 1.1 A, 181.3 BTU/hr
- Dimensions
  - Height: 12.650 in. (321.3 mm)
  - Width: 0.913 in. (23.19 mm)
  - Depth: 9.073 in. (230.45 mm)
  - Weight (not including clam shell): 1.8 lb (0.82 kg)

A.7.5 G1K-4 Card Specifications

The G1K-4 card has the following specifications:

- Environmental
  - Operating temperature: –5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 63.00 W, 1.31 A at –48 V, 215.1 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Depth with backplane connector: 235 mm (9.250 in.)
  - Weight (not including clam shell): 2.1 lb (0.9 kg)
- Compliance. ONS 15454 SDH optical cards, when installed in a system, comply with these standards:
  - Safety: IEC 60950, EN 60950, UL 60950, CSA C22.2 No. 60950, TS 001, AS/NZS 3260, IEC 60825-1, IEC 60825-2, 21 CFR 1040-10, and 21 CFR 1040.11
  - Class 1 laser product

A.7.6 ML100T-12 Card Specifications

The ML100T-12 card has the following specifications:

- Environmental
  - Operating temperature: –5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 53.00 W, 1.10 A at –48 V, 181.0 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)

  - Depth: 228.6 mm (9.000 in.)
  - Depth with backplane connector: 235 mm (9.250 in.)
  - Weight (not including clam shell): 2.3 lb (1.0 kg)
- Compliance. ONS 15454 SDH cards, when installed in a system, comply with these standards:
  - Safety: IEC 60950, EN 60950, UL 60950, CSA C22.2 No. 60950, TS 001, and AS/NZS 3260

A.7.7 ML1000-2 Card Specifications

The ML1000-2 card has the following specifications:

- Environmental
  - Operating temperature: –5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 49.00 W, 1.02 A at –48 V, 167.3 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Depth with backplane connector: 235 mm (9.250 in.)
  - Weight (not including clam shell): 2.1 lb (0.9 kg)
- Compliance: ONS 15454 SDH optical cards, when installed in a system, comply with these standards:
  - Safety: IEC 60950, EN 60950, UL 60950, CSA C22.2 No. 60950, TS 001, AS/NZS 3260, IEC 60825-1, IEC 60825-2, 21 CFR 1040-10, and 21 CFR 1040.11
  - Class 1 laser product

A.7.8 ML100X-8 Card Specifications

The ML100X-8 card has the following specifications:

- Environmental
  - Operating temperature: –5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 65.00 W, 1.35 A at –48 V, 221.93 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Depth with backplane connector: 235 mm (9.250 in.)
  - Weight (not including clam shell): 2.1 lb (0.9 kg)

A.8 Storage Access Networking Card Specifications

This section provides specifications for the FC_MR-4 (Fibre Channel) card.

For compliance information, refer to the *Cisco Optical Transport Products Safety and Compliance Information* document.

A.8.1 FC_MR-4 Card Specifications

- Environmental
  - Operating temperature

    C-Temp (15454-E100T): –5 to +55 degrees Celsius (23 to 131 degrees Fahrenheit)
  - Operating humidity: 5 to 95 percent, noncondensing
  - Power consumption: 60 W, 1.35 A, 221.93 BTU/hr
- Dimensions
  - Height: 321.3 mm (12.650 in.)
  - Width: 18.2 mm (0.716 in.)
  - Depth: 228.6 mm (9.000 in.)
  - Weight (not including clam shell): 1.17 kg (2.59 lb)

Administrative and Service States

This appendix describes the administrative and service states for Cisco ONS 15454 SDH cards, ports, and cross-connects. For circuit state information, see Chapter 11, "Circuits and Tunnels." Software Release 5.0 and later states are based on the generic state model defined in Telcordia GR-1093-CORE, Issue 2 and ITU-T X.731.

B.1 Service States

Service states include a Primary State (PST), a Primary State Qualifier (PSTQ), and one or more Secondary States (SST). Table B-1 lists the service state PSTs and PSTQs supported by the ONS 15454 SDH.

Table B-1 ONS 15454 SDH Service State Primary States and Primary State Qualifiers

Primary State, Primary State Qualifier	Definition
Unlocked-enabled	The entity is fully operational and will perform as provisioned.
Unlocked-disabled	The entity is not operational because of an autonomous event.
Locked-disabled	The entity is not operational because of an autonomous event and has also been manually removed from service.
Locked-enabled	The entity has been manually removed from service.

Table B-2 defines the SSTs supported by the ONS 15454 SDH.

Table B-2 ONS 15454 SDH Secondary States

Secondary State	Definition
automaticInService	The entity is delayed before transitioning to the Unlocked-enabled service state. The transition to the Unlocked-enabled state depends on the correction of conditions, or on a soak timer. Alarm reporting is suppressed, but traffic is carried. Raised fault conditions, whether or not their alarms are reported, can be retrieved on the CTC Conditions tab or by using the TL1 RTRV-COND command.
disabled	The entity was manually removed from service and does not provide its provisioned functions. All services are disrupted; the entity is unable to carry traffic. **Note** STM-N ports and connections in the disabled state continue to send an Alarm Indication Signal Line (AIS-L).
failed	The entity has a raised alarm or condition.
loopback	The entity is in loopback mode.
mismatchOfEquipment	An improper card is installed, a cross-connect card does not support an installed card, or an incompatible backplane is installed. For example, an installed card is not compatible with the card preprovisioning or the slot. This SST applies only to cards.
maintenance	The entity has been manually removed from service for a maintenance activity but still performs its provisioned functions. Alarm reporting is suppressed, but traffic is carried. Raised fault conditions, whether or not their alarms are reported, can be retrieved on the CTC Conditions tab or by using the TL1 RTRV-COND command.
outOfGroup	The virtual concatenation (VCAT) member cross-connect is not used to carry VCAT group traffic. This state is used to put a member circuit out of the group and to stop sending traffic. Locked-enabled,outOfGroup only applies to the cross-connects on an end node where VCAT resides. The cross-connects on intermediate nodes are in the Locked-enabled,maintenance service state.
softwareDownload	The card is involved in a software download. This SST applies only to cards.
unassigned	The card is not provisioned in the database. This SST applies only to cards.
notInstalled	The card is not physically present (that is, an empty slot). This SST applies only to cards.

B.2 Administrative States

Administrative states are used to manage service states. Administrative states consist of a PST and an SST. Table B-3 lists the administrative states supported by the ONS 15454 SDH. See Table B-2 for SST definitions.

Note When an entity is put in the Locked,maintenance administrative state, the ONS 15454 SDH suppresses all standing alarms on that entity. All alarms and events appear on the Conditions tab. You can change this behavior for the LPBKFACILITY and LPBKTERMINAL alarms. To display these alarms on the Alarms tab, set the NODE.general.ReportLoopbackConditionsOnUnlocked,MaintenancePorts to TRUE on the NE Defaults tab.

Note A change in the administrative state of an entity does not change the service state of supporting or supported entities.

Table B-3 ONS 15454 SDH Administrative States

Administrative State (PST,SST)	Definition
Unlocked	Puts the entity in service.
Unlocked,automaticInservice	Puts the entity in automatic in-service.
Locked,disabled	Removes the entity from service and disables it.
Locked,maintenance	Removes the entity from service for maintenance.
Locked,outOfGroup	(VCAT circuits only) Removes a VCAT member cross-connect from service and from the group of members.

B.3 Service State Transitions

This section describes the transition from one service state to the next for cards, ports, and cross-connects. A service state transition is based on the action performed on the entity.

B.3.1 Card Service State Transitions

Table B-4 lists card service state transitions.

Table B-4 ONS 15454 SDH Card Service State Transitions

Current Service State	Action	Next Service State
Unlocked-enabled	Change the administrative state to Locked,maintenance.	Locked-enabled,maintenance
	Delete the card.	Locked-disabled,unassigned
	Pull the card.	Unlocked-disabled,notInstalled
	Reset the card.	Unlocked-disabled,softwareDownload
	Alarm/condition is raised.	Unlocked-disabled,failed

Table B-4 ONS 15454 SDH Card Service State Transitions (continued)

Current Service State	Action	Next Service State
Unlocked-disabled,automaticInService and mismatchOfEquipment	Pull the card.	Unlocked-disabled,automaticInService & notInstalled
	Delete the card.	Locked-disabled,unassigned if the card is valid Locked-disabled,mismatchOfEquipment & unassigned if the card is invalid
Unlocked-disabled,automaticInService & softwareDownload	Restart completed.	Unlocked-enabled
	Pull the card.	Unlocked-disabled,automaticInService & notInstalled
Unlocked-disabled,automaticInService & notInstalled	Insert a valid card.	Unlocked-disabled,automaticInService & softwareDownload
	Insert an invalid card.	Unlocked-disabled,automaticInService & mismatchOfEquipment
	Delete the card.	Locked-disabled,unassigned & notInstalled
Unlocked-disabled,mismatchOfEquipment	Pull the card.	Unlocked-disabled,notInstalled
	Delete the card.	Locked-disabled,unassigned if the card is valid Locked-disabled,mismatchOfEquipment & unassigned if the card is invalid
	Change the administrative state to Locked,maintenance.	Locked-disabled,mismatchOfEquipment & maintenance
Unlocked-disabled,softwareDownload	Restart completed.	Unlocked-enabled
	Pull the card.	Unlocked-disabled,notInstalled
Unlocked-disabled,notInstalled	Insert a valid card.	Unlocked-disabled,softwareDownload
	Insert an invalid card.	Unlocked-disabled,mismatchOfEquipment
	Delete the card.	Locked-disabled,unassigned & notInstalled
	Change the administrative state to Locked,maintenance.	Locked-disabled,maintenance & notInstalled
Unlocked-disabled,failed	Pull the card.	Unlocked-disabled,unequipped
	Delete the card.	Locked-disabled,unassigned
	Change the administrative state to Locked,maintenance.	Locked-disabled,failed & maintenance
	Reset the card.	Unlocked-disabled,softwareDownload
	Alarm/condition is cleared.	Unlocked-enabled

Table B-4 ONS 15454 SDH Card Service State Transitions (continued)

Current Service State	Action	Next Service State
Locked-disabled,mismatchOfEquipment & maintenance	Change the administrative state to Unlocked.	Unlocked-disabled,mismatchOfEquipment
	Pull the card.	Locked-disabled,maintenance & notInstalled
	Delete the card.	Locked-disabled,unassigned if the card is valid Locked-disabled,mismatchOfEquipment & unassigned if the card is invalid
Locked-disabled,mismatchOfEquipment & unassigned	Pull the card.	Locked-disabled,unassigned & notInstalled
	Provision the card.	Unlocked-disabled,mismatchOfEquipment
Locked-disabled,maintenance & softwareDownload	Restart completed.	Locked-enabled,maintenance
	Pull the card.	Locked-disabled,maintenance & notInstalled
Locked-disabled,maintenance & notInstalled	Change the administrative state to Unlocked.	Unlocked-disabled,notInstalled
	Insert a valid card.	Locked-disabled,maintenance & softwareDownload
	Insert an invalid card.	Locked-disabled,mismatchOfEquipment & maintenance
	Delete the card.	Locked-disabled,unassigned & notInstalled
Locked-disabled,unassigned	Pull the card.	Locked-disabled,unassigned & notInstalled
	Provision an invalid card.	Unlocked-disabled,mismatchOfEquipment
	Provision a valid card.	Unlocked-disabled,softwareDownload
Locked-disabled,unassigned & notInstalled	Insert a valid card.	Unlocked-disabled,softwareDownload
	Insert an invalid card.	Locked-disabled,mismatchOfEquipment & unassigned
	Preprovision a card.	Unlocked-disabled,automaticInService & notInstalled
Locked-disabled,failed & maintenance	Pull the card.	Locked-disabled,maintenance & notInstalled
	Delete the card.	Locked-disabled,unassigned
	Change the administrative state to Unlocked.	Unlocked-disabled,failed
	Reset the card.	Locked-disabled,maintenance & softwareDownload
	Alarm/condition is cleared.	Unlocked-enabled

Table B-4 ONS 15454 SDH Card Service State Transitions (continued)

Current Service State	Action	Next Service State
Locked-enabled,maintenance	Change the administrative state to Unlocked.	Unlocked-enabled
	Delete the card.	Locked-disabled,unassigned
	Pull the card.	Locked-disabled,maintenance & notInstalled
	Reset the card.	Locked-disabled,maintenance & softwareDownloadunassigned
	Alarm/condition is raised.	Locked-disabled,failed & maintenance

B.3.2 Port and Cross-Connect Service State Transitions

Table B-5 lists the port and cross-connect service state transitions. Port states do not impact cross-connect states with one exception. A cross-connect in the Unlocked-disabled,automaticInService service state cannot transition autonomously into the Unlocked-enabled service state until the parent port is Unlocked-enabled.

The following ports do not support all of the service states listed in Table B-5:

- E-Series Ethernet ports do not support service states; these ports are either enabled or disabled.
- FC_MR-4 ports support the Unlocked-enabled; Locked-enabled,disabled; and Locked-enabled,maintenance service states; they do not support the Unlocked-disabled,automaticInService service state.

Note Deleting a port or cross-connect removes the entity from the system. The deleted entity does not transition to another service state.

Table B-5 ONS 15454 SDH Port and Cross-Connect Service State Transitions

Current Service State	Action	Next Service State
Unlocked-enabled	Put the port or cross-connect in the Locked,maintenance administrative state.	Locked-enabled,maintenance
	Put the port or cross-connect in the Locked,disabled administrative state.	Locked-enabled,disabled Locked-enabled,disabled & outOfGroup for a VCAT cross-connect
	Put the port or cross-connect in the Unlocked,automaticInService administrative state.	Unlocked-disabled,automaticInService[1]
	Put the VCAT cross-connect in the Locked,outOfGroup administrative state.	Locked-enabled,maintenance & outOfGroup
	Alarm/condition is raised.	Unlocked-disabled,failed Unlocked-disabled,failed & outOfGroup for a VCAT member
Unlocked-disabled,automaticInService	Put the port or cross-connect in the Unlocked administrative state.	Unlocked-enabled
	Put the port or cross-connect in the Locked,maintenance administrative state.	Locked-enabled,maintenance
	Put the port or cross-connect in the Locked,disabled administrative state.	Locked-enabled,disabled Locked-enabled,disabled & outOfGroup for a VCAT cross-connect
	Put the VCAT cross-connect in the Locked,outOfGroup administrative state.	Locked-enabled,maintenance and outOfGroup
	Alarm/condition is raised.	Unlocked-disabled,automaticInService & failed Unlocked-disabled,automaticInService & failed & outOfGroup for a VCAT member
Unlocked-disabled,automaticInService & failed	Alarm/condition is cleared.	Unlocked-disabled,automaticInService
	Put the port or cross-connect in the Unlocked administrative state.	Unlocked-disabled,failed
	Put the port or cross-connect in the Locked,disabled administrative state.	Locked-enabled,disabled
	Put the port or cross-connect in the Locked,maintenance administrative state.	Locked-disabled,failed & maintenance
	Put the VCAT member in the Locked,outOfGroup administrative state.	Locked-disabled,failed & maintenance & outOfGroup

Table B-5 ONS 15454 SDH Port and Cross-Connect Service State Transitions (continued)

Current Service State	Action	Next Service State
Unlocked-disabled,automaticInService & failed & outOfGroup	Alarm/condition is cleared.	Unlocked-disabled,automaticInService or Locked-enabled,maintenance • If an In Group member is Unlocked-enabled or Unlocked-disabled,automaticInService, the member transitions to Unlocked-disabled,automaticInService. • If an In Group member is Locked-enabled,maintenance, the member transitions to Locked-enabled,maintenance.
	Put the VCAT member in the Unlocked administrative state.	Unlocked-disabled,failed and outOfGroup
	Put the VCAT member in the Locked,disabled administrative state.	Locked-enabled,disabled and outOfGroup
	Put the VCAT member in the Locked,maintenance administrative state.	Locked-disabled,failed & maintenance & outOfGroup
Unlocked-disabled,failed	Alarm/condition is cleared.	Unlocked-enabled
	Put the port or cross-connect in the Unlocked,automaticInService administrative state.	Unlocked-disabled,automaticInService & failed
	Put the port or cross-connect in the Locked,disabled administrative state.	Locked-enabled,disabled Locked-enabled,disabled & outOfGroup for a VCAT member
	Put the port or cross-connect in the Locked,maintenance administrative state	Locked-disabled,failed & maintenance
	Put the VCAT member in the Locked,outOfGroup administrative state.	Locked-disabled,failed & maintenance & outOfGroup

Table B-5 ONS 15454 SDH Port and Cross-Connect Service State Transitions (continued)

Current Service State	Action	Next Service State
Unlocked-disabled,failed and outOfGroup	Alarm/condition is cleared.	Unlocked-enabled or Locked-enabled,maintenance • If an In Group member is Unlocked-enabled or Unlocked-disabled,automaticInService, the member transitions to Unlocked-enabled. • If an In Group member is Locked-enabled,maintenance, the member transitions to Locked-enabled,maintenance.
	Put the VCAT member in the Unlocked,automaticInService administrative state.	Unlocked-disabled,automaticInService & failed & outOfGroup
	Put the VCAT member in the Locked,disabled administrative state.	Locked-enabled,disabled & outOfGroup
	Put the VCAT member in the Locked,maintenance administrative state.	Locked-disabled,failed & maintenance & outOfGroup
Locked-disabled,failed & loopback & maintenance	Release the loopback.	Locked-disabled,failed & maintenance
	Alarm/condition is cleared.	Locked-enabled,loopback & maintenance
Locked-disabled,failed & loopback & maintenance & outOfGroup	Release the loopback.	Locked-disabled,failed & maintenance & outOfGroup
	Alarm/condition is cleared.	Locked-enabled,maintenance & outOfGroup
Locked-disabled,failed & maintenance	Alarm/condition is cleared.	Locked-enabled,maintenance
	Put the port or cross-connect in the Unlocked-enabled administrative state.	Unlocked-disabled,failed
	Put the port or cross-connect in the Unlocked,automaticInService administrative state.	Unlocked-disabled,automaticInService & failed
	Put the port or cross-connect in the Locked,disabled administrative state.	Locked-enabled,disabled Locked-enabled,disabled & outOfGroup for a VCAT member
	Put the port or cross-connect in a loopback.	Locked-disabled,failed & loopback & maintenance
	Put the VCAT member in the Locked,outOfGroup administrative state.	Locked-disabled,failed & maintenance & outOfGroup

Table B-5 ONS 15454 SDH Port and Cross-Connect Service State Transitions (continued)

Current Service State	Action	Next Service State
Locked-disabled,failed & maintenance & outOfGroup	Alarm/condition is cleared.	Locked-enabled,maintenance & outOfGroup
	Put the VCAT member in the Unlocked administrative state. **Note** VCAT In Group members are in the Unlocked-disabled,failed or Unlocked-enabled service state.	Unlocked-disabled,failed & outOfGroup
	Put the VCAT member in the Unlocked,automaticInService administrative state. **Note** VCAT In Group members are in the Unlocked-disabled,automaticInService & failed or Unlocked-enabled service state.	Unlocked-disabled,automaticInService & failed & outOfGroup
	Put the VCAT member in the Locked,disabled administrative state.	Locked-enabled,disabled & outOfGroup
	Put the VCAT member in the Locked,maintenance administrative state. **Note** VCAT In Group members are in the Locked-enabled,failed & maintenance service state.	Locked-enabled,failed & maintenance
	Operate a loopback.	Locked-enabled,failed & loopback & maintenance & outOfGroup
Locked-enabled,disabled	Put the port or cross-connect in the Unlocked administrative state.	Unlocked-enabled
	Put the port or cross-connect in the Unlocked,automaticInService administrative state.	Unlocked-disabled,automaticInService
	Put the port or cross-connect in the Locked,maintenance.	Locked-enabled,maintenance
	Put the VCAT cross-connect in the Locked,outOfGroup administrative state.	Locked-enabled,maintenance & outOfGroup
	Put the VCAT member in the Locked,outOfGroup administrative state.	Locked-enabled,maintenance & outOfGroup

Table B-5 ONS 15454 SDH Port and Cross-Connect Service State Transitions (continued)

Current Service State	Action	Next Service State
Locked-enabled,loopback & maintenance	Release the loopback. **Note** While in Locked-enabled, loopback & maintenance service state, both Cisco Transport Controller (CTC) and Transaction Language One (TL1) allow a cross-connect to be deleted, which also removes the loopback. This applies only to the cross-connect, not the ports.	Locked-enabled,maintenance
	Alarm/condition is raised.	Locked-disabled,failed & loopback & maintenance Locked-disabled,failed & loopback & maintenance & outOfGroup for a VCAT member
Locked-enabled,loopback & maintenance & outOfGroup	Alarm/condition is raised.	Locked-disabled,failed & loopback & maintenance & outOfGroup
Locked-enabled,maintenance	Put the port or cross-connect in the Unlocked administrative state.	Unlocked-enabled
	Put the port or cross-connect in the Unlocked,automaticInService administrative state.	Unlocked-disabled,automaticInService
	Put the port or cross-connect in the Locked,disabled.	Locked-enabled,disabled Locked-enabled,disabled & outOfGroup for a VCAT cross-connect
	Put the port or cross-connect in a loopback.	Locked-enabled,loopback & maintenance
	Put the VCAT cross-connect in the Locked,outOfGroup administrative state.	Locked-enabled,maintenance & outOfGroup
	Alarm/condition is raised.	Locked-disabled,failed & maintenance Locked-disabled,failed & maintenance & outOfGroup for a VCAT member
Locked-enabled,maintenance & outOfGroup	Alarm/condition is raised.	Locked-disabled,failed & maintenance & outOfGroup

1. For a VCAT member, an Unlocked-enabled to Unlocked-disabled,automaticInService transition will not occur with a Loss of Multiframe (LOM) or Sequence Mismatch (SQM) condition on the member.

Network Element Defaults

This appendix describes the factory-configured (default) network element (NE) settings for the Cisco ONS 15454 SDH. It includes descriptions of card, node, and Cisco Transport Controller (CTC) default settings. To import, export, or edit the settings, refer to the "Maintain the Node" chapter of the *Cisco ONS 15454 SDH Procedure Guide*. Cards supported by this platform that are not listed in this appendix are not supported by user-configurable NE defaults settings.

To change card settings individually (that is, without directly changing the NE defaults), refer to the "Change Card Settings" chapter of the *Cisco ONS 15454 SDH Procedure Guide*. To change node settings, refer to the "Change Node Settings" chapter of the *Cisco ONS 15454 SDH Procedure Guide*.

This appendix includes the following sections:

- C.1 Network Element Defaults Description, page C-1
- C.2 Card Default Settings, page C-2
- C.3 Node Default Settings, page C-46
- C.4 CTC Default Settings, page C-58

C.1 Network Element Defaults Description

The NE defaults are preinstalled on each Cisco ONS 15454 SDH Advanced Timing, Communications, and Control (TCC2) or Advanced Timing, Communications, and Control Plus (TCC2P) card. They also ship as a file called 15454SDH-defaults.txt on the CTC software CD in case you want to import the defaults onto existing TCC2/TCC2P cards. The NE defaults include card-level, CTC, and node-level defaults.

Changes to card provisioning that are made manually using the "Change Card Settings" chapter in the *Cisco ONS 15454 SDH Procedure Guide* override default settings. If you use the CTC Defaults editor (in the node view Provisioning > Defaults tab) or import a new defaults file, any changes to card or port settings that result only affect cards that are installed or preprovisioned after the defaults have changed.

Changes that are made manually to most node-level default settings override the current settings, whether default or provisioned. If you change node-level default settings, either by using the Defaults editor or by importing a new defaults file, the new defaults reprovision the node immediately for all settings except those relating to protection (subnetwork connection protection [SNCP], multiplex section-shared protection ring [MS-SPRing], Linear, etc.), which apply to subsequent provisioning.

Note Changing some node-level provisioning via NE defaults can cause CTC disconnection or a reboot of the node in order for the provisioning to take effect. Before you change a default, check in the Side Effects column of the Defaults editor (right-click a column header and select **Show Column > Side Effects**) and be prepared for the occurrence of any side effects listed for that default.

C.2 Card Default Settings

The tables in this section list the default settings for each SDH card. Cisco provides several types of user-configurable defaults for Cisco ONS 15454 SDH optical, electrical, storage access networking, and Ethernet (or data) cards. Types of card defaults can be broadly grouped by function, as outlined in the following subsections. For information about individual card settings, refer to the "Change Card Settings" chapter of the *Cisco ONS 15454 SDH Procedure Guide*.

Note When the card level defaults are changed, the new provisioning done after the defaults have changed is affected. Existing provisioning remains unaffected.

Note To view DWDM card defaults consult the *Cisco ONS 15454 DWDM Reference Manual*.

The following types of defaults are defined for SONET cards.

C.2.1 Configuration Defaults

Most card and port-level configuration defaults correspond to settings found in the CTC card-level Provisioning tabs.

Note The full set of Automatic Laser Shutdown (ALS) configuration defaults can be found in the CTC card-level Maintenance > ALS tab for supported cards. ALS defaults are supported for STM1-8, STM16, STM64, STM64-XFP, and MRC-12 cards.

Configuration defaults that correspond to settings that are reachable from the CTC card-level Provisioning tabs (except as noted) include the following types of options (arranged by CTC subtab):

- Line—(E1-N-14, E1-42, E3-12, DS3i-N-12, STM-N, MRC-12, G-series, and CE-series cards) Line-level configuration settings.

Note MRC-12 line configuration defaults are defined on a per STM-N rate basis.

- VC4—(STM-N cards) VC4-level configuration settings.
- Port—(FC_MR-4 cards only) Port line-level configuration, distance extension, and enhanced FC/FICON ISL settings.
- Card—(ML-series, and FC_MR-4 cards) FC_MR-4 card mode settings (FC_MR-4 only); or framing mode (ML-series cards).

- ALS (card-level Maintenance > ALS tab)—(STM1-8, STM16, STM64, STM64-XFP, and MRC-12 cards) ALS configuration defaults.
- IOS (card-level IOS tab)—(ML-series cards) Console port and RADIUS server access settings.
- Ether Ports—(CE-series cards) Line configuration settings (including 802 class of service [IEEE 802.1p CoS] and IP type of service [ToS]).
- POS Ports—(CE-series cards) Line configuration settings.

Note Line configuration defaults for the CE-100T-8 card apply to both Ethernet port and packet-over-SONET (POS) port settings where the same setting exists for both.

Note For further information about supported features of each individual card, refer to Chapter 3, "Electrical Cards," Chapter 4, "Optical Cards," Chapter 5, "Ethernet Cards," or Chapter 6, "Storage Access Networking Cards."

Note For further information about IOS configuration defaults for the ML-series cards, consult the *Ethernet Card Software Feature and Configuration Guide for the Cisco ONS 15454, Cisco ONS 15454 SDH, and Cisco ONS 15327.*

C.2.2 Threshold Defaults

Threshold default settings define the default cumulative values (thresholds) beyond which a threshold crossing alert (TCA) will be raised, making it possible to monitor the network and detect errors early.

Card threshold default settings are provided as follows:

- PM thresholds—(E1-N-14, E1-42, E3-12, DS3i-N-12, STM-N, and MRC-12 cards) Can be expressed in counts or seconds; includes line, electrical path, and SONET thresholds.
- Physical Layer thresholds—(STM1-8, STM64, STM64-XFP, and MRC-12 cards) Expressed in percentages; includes optics thresholds.

Threshold defaults are defined for near end and/or far end, at 15-minute and one-day intervals. Thresholds are further broken down by type, such as Path, Line, vc4, or pbitpath for performance monitoring (PM) thresholds, and TCA (warning) or Alarm for physical thresholds. PM threshold types define the layer to which the threshold applies. Physical threshold types define the level of response expected when the threshold is crossed.

Note For full descriptions of the thresholds you can set for each card, see Chapter 15, "Performance Monitoring."

Note For additional information regarding PM parameter threshold defaults as defined by Telcordia specifications, refer to Telcordia GR-820-CORE and GR-253-CORE.

C.2.3 Defaults by Card

In the tables that follow, card defaults are defined by the default name, its factory-configured value, and the domain of allowable values that you can assign to it.

Note Some default values, such as certain thresholds, are interdependent. Before changing a value, review the domain for that default and any other related defaults for potential dependencies.

C.2.3.1 E1-N-14 Card Default Settings

Table C-1 lists the E1-N-14 card default settings.

Table C-1 E1-N-14 Card Default Settings

Default Name	Default Value	Default Domain
E1.config.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
E1.config.LineType	E1_MF	E1_MF, E1_CRCMF, E1_UNFRAMED
E1.config.SDBER	1.00E-07	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
E1.config.SFBER	1.00E-04	1E-3, 1E-4, 1E-5
E1.config.State	unlocked, automaticInService	unlocked, locked, disabled, locked, maintenance, unlocked, automaticInService
E1.pmthresholds.line.nearend.15min.CV	9 (BPV count)	0 - 1388700
E1.pmthresholds.line.nearend.15min.ES	65 (seconds)	0 - 900
E1.pmthresholds.line.nearend.15min.LOSS	10 (seconds)	0 - 900
E1.pmthresholds.line.nearend.15min.SES	10 (seconds)	0 - 900
E1.pmthresholds.line.nearend.1day.CV	90 (BPV count)	0 - 133315200
E1.pmthresholds.line.nearend.1day.ES	648 (seconds)	0 - 86400
E1.pmthresholds.line.nearend.1day.LOSS	10 (seconds)	0 - 900
E1.pmthresholds.line.nearend.1day.SES	100 (seconds)	0 - 86400
E1.pmthresholds.path.farend.15min.BBE	0 (count)	0 - 287100
E1.pmthresholds.path.farend.15min.EB	0 (count)	0 - 450000
E1.pmthresholds.path.farend.15min.ES	0 (seconds)	0 - 900
E1.pmthresholds.path.farend.15min.SES	0 (seconds)	0 - 900
E1.pmthresholds.path.farend.15min.UAS	0 (seconds)	0 - 900
E1.pmthresholds.path.farend.1day.BBE	0 (count)	0 - 27561600
E1.pmthresholds.path.farend.1day.EB	0 (count)	0 - 450000
E1.pmthresholds.path.farend.1day.ES	0 (seconds)	0 - 86400
E1.pmthresholds.path.farend.1day.SES	0 (seconds)	0 - 86400
E1.pmthresholds.path.farend.1day.UAS	0 (seconds)	0 - 86400
E1.pmthresholds.path.nearend.15min.AISS	10 (seconds)	0 - 900
E1.pmthresholds.path.nearend.15min.BBE	9 (count)	0 - 287100

Table C-1 E1-N-14 Card Default Settings (continued)

Default Name	Default Value	Default Domain
E1.pmthresholds.path.nearend.15min.EB	9 (count)	0 - 450000
E1.pmthresholds.path.nearend.15min.ES	65 (seconds)	0 - 900
E1.pmthresholds.path.nearend.15min.SES	10 (seconds)	0 - 900
E1.pmthresholds.path.nearend.15min.UAS	10 (seconds)	0 - 900
E1.pmthresholds.path.nearend.1day.AISS	10 (seconds)	0 - 86400
E1.pmthresholds.path.nearend.1day.BBE	90 (count)	0 - 27561600
E1.pmthresholds.path.nearend.1day.EB	90 (count)	0 - 43200000
E1.pmthresholds.path.nearend.1day.ES	648 (seconds)	0 - 86400
E1.pmthresholds.path.nearend.1day.SES	100 (seconds)	0 - 86400
E1.pmthresholds.path.nearend.1day.UAS	10 (seconds)	0 - 86400
E1.pmthresholds.vclo.farend.15min.BBE	15 (count)	0 - 539100
E1.pmthresholds.vclo.farend.15min.EB	18 (count)	0 - 1800000
E1.pmthresholds.vclo.farend.15min.ES	65 (seconds)	0 - 900
E1.pmthresholds.vclo.farend.15min.SES	10 (seconds)	0 - 900
E1.pmthresholds.vclo.farend.15min.UAS	10 (seconds)	0 - 900
E1.pmthresholds.vclo.farend.1day.BBE	150 (count)	0 - 51753600
E1.pmthresholds.vclo.farend.1day.EB	180 (count)	0 - 172800000
E1.pmthresholds.vclo.farend.1day.ES	648 (seconds)	0 - 86400
E1.pmthresholds.vclo.farend.1day.SES	100 (seconds)	0 - 86400
E1.pmthresholds.vclo.farend.1day.UAS	10 (seconds)	0 - 86400
E1.pmthresholds.vclo.nearend.15min.BBE	15 (count)	0 - 539100
E1.pmthresholds.vclo.nearend.15min.EB	18 (count)	0 - 1800000
E1.pmthresholds.vclo.nearend.15min.ES	65 (seconds)	0 - 900
E1.pmthresholds.vclo.nearend.15min.SES	10 (seconds)	0 - 900
E1.pmthresholds.vclo.nearend.15min.UAS	10 (seconds)	0 - 900
E1.pmthresholds.vclo.nearend.1day.BBE	150 (count)	0 - 51753600
E1.pmthresholds.vclo.nearend.1day.EB	180 (count)	0 - 172800000
E1.pmthresholds.vclo.nearend.1day.ES	648 (seconds)	0 - 86400
E1.pmthresholds.vclo.nearend.1day.SES	100 (seconds)	0 - 86400
E1.pmthresholds.vclo.nearend.1day.UAS	10 (seconds)	0 - 86400

C.2.3.2 E1-42 Card Default Settings

Table C-2 lists the E1-42 card default settings.

Table C-2 E1-42 Card Default Settings

Default Name	Default Value	Default Domain
E1_42.config.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
E1_42.config.LineCoding	HDB3	HDB3
E1_42.config.LineType	E1_MF	E1_MF, E1_CRCMF, E1_UNFRAMED
E1_42.config.SDBER	1.00E-07	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
E1_42.config.SFBER	1.00E-04	1E-3, 1E-4, 1E-5
E1_42.config.State	unlocked, automaticInServic e	unlocked, locked, disabled, locked, maintenance, unlocked, automaticInService
E1_42.pmthresholds.line.nearend.15min.CV	9 (BPV count)	0 - 1388700
E1_42.pmthresholds.line.nearend.15min.ES	65 (seconds)	0 - 900
E1_42.pmthresholds.line.nearend.15min.LOSS	10 (seconds)	0 - 900
E1_42.pmthresholds.line.nearend.15min.SES	10 (seconds)	0 - 900
E1_42.pmthresholds.line.nearend.1day.CV	90 (BPV count)	0 - 133315200
E1_42.pmthresholds.line.nearend.1day.ES	648 (seconds)	0 - 86400
E1_42.pmthresholds.line.nearend.1day.LOSS	10 (seconds)	0 - 900
E1_42.pmthresholds.line.nearend.1day.SES	100 (seconds)	0 - 86400
E1_42.pmthresholds.path.nearend.15min.BBE	9 (count)	0 - 287100
E1_42.pmthresholds.path.nearend.15min.EB	9 (count)	0 - 450000
E1_42.pmthresholds.path.nearend.15min.ES	65 (seconds)	0 - 900
E1_42.pmthresholds.path.nearend.15min.SES	10 (seconds)	0 - 900
E1_42.pmthresholds.path.nearend.15min.UAS	10 (seconds)	0 - 900
E1_42.pmthresholds.path.nearend.1day.BBE	90 (count)	0 - 27561600
E1_42.pmthresholds.path.nearend.1day.EB	90 (count)	0 - 43200000
E1_42.pmthresholds.path.nearend.1day.ES	648 (seconds)	0 - 86400
E1_42.pmthresholds.path.nearend.1day.SES	100 (seconds)	0 - 86400
E1_42.pmthresholds.path.nearend.1day.UAS	10 (seconds)	0 - 86400
E1_42.pmthresholds.vc4.farend.15min.BBE	25 (count)	0 - 2159100
E1_42.pmthresholds.vc4.farend.15min.EB	15 (count)	0 - 7200000
E1_42.pmthresholds.vc4.farend.15min.ES	12 (seconds)	0 - 900
E1_42.pmthresholds.vc4.farend.15min.SES	3 (seconds)	0 - 900
E1_42.pmthresholds.vc4.farend.15min.UAS	10 (seconds)	0 - 900
E1_42.pmthresholds.vc4.farend.1day.BBE	250 (count)	0 - 207273600
E1_42.pmthresholds.vc4.farend.1day.EB	125 (count)	0 - 691200000
E1_42.pmthresholds.vc4.farend.1day.ES	100 (seconds)	0 - 86400

Table C-2 E1-42 Card Default Settings (continued)

Default Name	Default Value	Default Domain
E1_42.pmthresholds.vc4.farend.1day.SES	7 (seconds)	0 - 86400
E1_42.pmthresholds.vc4.farend.1day.UAS	10 (seconds)	0 - 86400
E1_42.pmthresholds.vc4.nearend.15min.BBE	25 (count)	0 - 2159100
E1_42.pmthresholds.vc4.nearend.15min.EB	15 (count)	0 - 7200000
E1_42.pmthresholds.vc4.nearend.15min.ES	12 (seconds)	0 - 900
E1_42.pmthresholds.vc4.nearend.15min.SES	3 (seconds)	0 - 900
E1_42.pmthresholds.vc4.nearend.15min.UAS	10 (seconds)	0 - 900
E1_42.pmthresholds.vc4.nearend.1day.BBE	250 (count)	0 - 207273600
E1_42.pmthresholds.vc4.nearend.1day.EB	125 (count)	0 - 691200000
E1_42.pmthresholds.vc4.nearend.1day.ES	100 (seconds)	0 - 86400
E1_42.pmthresholds.vc4.nearend.1day.SES	7 (seconds)	0 - 86400
E1_42.pmthresholds.vc4.nearend.1day.UAS	10 (seconds)	0 - 86400
E1_42.pmthresholds.vclo.farend.15min.BBE	15 (count)	0 - 539100
E1_42.pmthresholds.vclo.farend.15min.EB	18 (count)	0 - 1800000
E1_42.pmthresholds.vclo.farend.15min.ES	65 (seconds)	0 - 900
E1_42.pmthresholds.vclo.farend.15min.SES	10 (seconds)	0 - 900
E1_42.pmthresholds.vclo.farend.15min.UAS	10 (seconds)	0 - 900
E1_42.pmthresholds.vclo.farend.1day.BBE	150 (count)	0 - 51753600
E1_42.pmthresholds.vclo.farend.1day.EB	180 (count)	0 - 172800000
E1_42.pmthresholds.vclo.farend.1day.ES	648 (seconds)	0 - 86400
E1_42.pmthresholds.vclo.farend.1day.SES	100 (seconds)	0 - 86400
E1_42.pmthresholds.vclo.farend.1day.UAS	10 (seconds)	0 - 86400
E1_42.pmthresholds.vclo.nearend.15min.BBE	15 (count)	0 - 539100
E1_42.pmthresholds.vclo.nearend.15min.EB	18 (count)	0 - 1800000
E1_42.pmthresholds.vclo.nearend.15min.ES	65 (seconds)	0 - 900
E1_42.pmthresholds.vclo.nearend.15min.SES	10 (seconds)	0 - 900
E1_42.pmthresholds.vclo.nearend.15min.UAS	10 (seconds)	0 - 900
E1_42.pmthresholds.vclo.nearend.1day.BBE	150 (count)	0 - 51753600
E1_42.pmthresholds.vclo.nearend.1day.EB	180 (count)	0 - 172800000
E1_42.pmthresholds.vclo.nearend.1day.ES	648 (seconds)	0 - 86400
E1_42.pmthresholds.vclo.nearend.1day.SES	100 (seconds)	0 - 86400
E1_42.pmthresholds.vclo.nearend.1day.UAS	10 (seconds)	0 - 86400

C.2.3.3 E3-12 Card Default Settings

Table C-3 lists the E3-12 card default settings.

Table C-3 E3-12 Card Default Settings

Default Name	Default Value	Default Domain
E3.config.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
E3.config.SDBER	1.00E-07	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
E3.config.SFBER	1.00E-04	1E-3, 1E-4, 1E-5
E3.config.State	unlocked, automaticInService	unlocked, locked, disabled, locked, maintenance, unlocked, automaticInService
E3.pmthresholds.line.nearend.15min.CV	387 (BPV count)	0 - 38700
E3.pmthresholds.line.nearend.15min.ES	25 (seconds)	0 - 900
E3.pmthresholds.line.nearend.15min.LOSS	10 (seconds)	0 - 900
E3.pmthresholds.line.nearend.15min.SES	4 (seconds)	0 - 900
E3.pmthresholds.line.nearend.1day.CV	3865 (BPV count)	0 - 3715200
E3.pmthresholds.line.nearend.1day.ES	250 (seconds)	0 - 86400
E3.pmthresholds.line.nearend.1day.LOSS	10 (seconds)	0 - 86400
E3.pmthresholds.line.nearend.1day.SES	40 (seconds)	0 - 86400
E3.pmthresholds.path.nearend.15min.ES	20 (seconds)	0 - 900
E3.pmthresholds.path.nearend.15min.SES	3 (seconds)	0 - 900
E3.pmthresholds.path.nearend.15min.UAS	10 (seconds)	0 - 900
E3.pmthresholds.path.nearend.1day.ES	200 (seconds)	0 - 86400
E3.pmthresholds.path.nearend.1day.SES	7 (seconds)	0 - 86400
E3.pmthresholds.path.nearend.1day.UAS	10 (seconds)	0 - 86400
E3.pmthresholds.vc4.farend.15min.BBE	25 (count)	0 - 2159100
E3.pmthresholds.vc4.farend.15min.EB	15 (count)	0 - 7200000
E3.pmthresholds.vc4.farend.15min.ES	12 (seconds)	0 - 900
E3.pmthresholds.vc4.farend.15min.SES	3 (seconds)	0 - 900
E3.pmthresholds.vc4.farend.15min.UAS	10 (seconds)	0 - 900
E3.pmthresholds.vc4.farend.1day.BBE	250 (count)	0 - 207273600
E3.pmthresholds.vc4.farend.1day.EB	125 (count)	0 - 691200000
E3.pmthresholds.vc4.farend.1day.ES	100 (seconds)	0 - 86400
E3.pmthresholds.vc4.farend.1day.SES	7 (seconds)	0 - 86400
E3.pmthresholds.vc4.farend.1day.UAS	10 (seconds)	0 - 86400
E3.pmthresholds.vc4.nearend.15min.BBE	25 (count)	0 - 2159100
E3.pmthresholds.vc4.nearend.15min.EB	15 (count)	0 - 7200000
E3.pmthresholds.vc4.nearend.15min.ES	12 (seconds)	0 - 900
E3.pmthresholds.vc4.nearend.15min.SES	3 (seconds)	0 - 900
E3.pmthresholds.vc4.nearend.15min.UAS	10 (seconds)	0 - 900
E3.pmthresholds.vc4.nearend.1day.BBE	250 (count)	0 - 207273600
E3.pmthresholds.vc4.nearend.1day.EB	125 (count)	0 - 691200000

Table C-3 E3-12 Card Default Settings (continued)

Default Name	Default Value	Default Domain
E3.pmthresholds.vc4.nearend.1day.ES	100 (seconds)	0 - 86400
E3.pmthresholds.vc4.nearend.1day.SES	7 (seconds)	0 - 86400
E3.pmthresholds.vc4.nearend.1day.UAS	10 (seconds)	0 - 86400
E3.pmthresholds.vclo.farend.15min.BBE	15 (count)	0 - 2159100
E3.pmthresholds.vclo.farend.15min.EB	15 (count)	0 - 7200000
E3.pmthresholds.vclo.farend.15min.ES	12 (seconds)	0 - 900
E3.pmthresholds.vclo.farend.15min.SES	3 (seconds)	0 - 900
E3.pmthresholds.vclo.farend.15min.UAS	10 (seconds)	0 - 900
E3.pmthresholds.vclo.farend.1day.BBE	150 (count)	0 - 207273600
E3.pmthresholds.vclo.farend.1day.EB	125 (count)	0 - 691200000
E3.pmthresholds.vclo.farend.1day.ES	100 (seconds)	0 - 86400
E3.pmthresholds.vclo.farend.1day.SES	7 (seconds)	0 - 86400
E3.pmthresholds.vclo.farend.1day.UAS	10 (seconds)	0 - 86400
E3.pmthresholds.vclo.nearend.15min.BBE	15 (count)	0 - 2159100
E3.pmthresholds.vclo.nearend.15min.EB	15 (count)	0 - 7200000
E3.pmthresholds.vclo.nearend.15min.ES	12 (seconds)	0 - 900
E3.pmthresholds.vclo.nearend.15min.SES	3 (seconds)	0 - 900
E3.pmthresholds.vclo.nearend.15min.UAS	10 (seconds)	0 - 900
E3.pmthresholds.vclo.nearend.1day.BBE	150 (count)	0 - 207273600
E3.pmthresholds.vclo.nearend.1day.EB	125 (count)	0 - 691200000
E3.pmthresholds.vclo.nearend.1day.ES	100 (seconds)	0 - 86400
E3.pmthresholds.vclo.nearend.1day.SES	7 (seconds)	0 - 86400
E3.pmthresholds.vclo.nearend.1day.UAS	10 (seconds)	0 - 86400

C.2.3.4 DS3i-N-12 Card Default Settings

Table C-4 lists the DS3i-N-12 card default settings.

Table C-4 DS3i-N-12 Card Default Settings

Default Name	Default Value	Default Domain
DS3I.config.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
DS3I.config.FeInhibitLpbk	FALSE	TRUE, FALSE
DS3I.config.LineLength	0 - 225 ft	0 - 225 ft, 226 - 450 ft
DS3I.config.LineType	C BIT	UNFRAMED, M13, C BIT, AUTO PROVISION FMT
DS3I.config.SDBER	1.00E-07	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
DS3I.config.SFBER	1.00E-04	1E-3, 1E-4, 1E-5

Table C-4 DS3i-N-12 Card Default Settings (continued)

Default Name	Default Value	Default Domain
DS3I.config.State	unlocked, automaticInService	unlocked, locked, disabled, locked, maintenance, unlocked, automaticInService
DS3I.pmthresholds.cpbitpath.farend.15min.CV	382 (count)	0 - 287100
DS3I.pmthresholds.cpbitpath.farend.15min.ES	25 (seconds)	0 - 900
DS3I.pmthresholds.cpbitpath.farend.15min.SAS	2 (seconds)	0 - 900
DS3I.pmthresholds.cpbitpath.farend.15min.SES	4 (seconds)	0 - 900
DS3I.pmthresholds.cpbitpath.farend.15min.UAS	10 (seconds)	0 - 900
DS3I.pmthresholds.cpbitpath.farend.1day.CV	3820 (count)	0 - 27561600
DS3I.pmthresholds.cpbitpath.farend.1day.ES	250 (seconds)	0 - 86400
DS3I.pmthresholds.cpbitpath.farend.1day.SAS	8 (seconds)	0 - 86400
DS3I.pmthresholds.cpbitpath.farend.1day.SES	40 (seconds)	0 - 86400
DS3I.pmthresholds.cpbitpath.farend.1day.UAS	10 (seconds)	0 - 86400
DS3I.pmthresholds.cpbitpath.nearend.15min.CV	382 (count)	0 - 287100
DS3I.pmthresholds.cpbitpath.nearend.15min.ES	25 (seconds)	0 - 900
DS3I.pmthresholds.cpbitpath.nearend.15min.SES	4 (seconds)	0 - 900
DS3I.pmthresholds.cpbitpath.nearend.15min.UAS	10 (seconds)	0 - 900
DS3I.pmthresholds.cpbitpath.nearend.1day.CV	3820 (count)	0 - 27561600
DS3I.pmthresholds.cpbitpath.nearend.1day.ES	250 (seconds)	0 - 86400
DS3I.pmthresholds.cpbitpath.nearend.1day.SES	40 (seconds)	0 - 86400
DS3I.pmthresholds.cpbitpath.nearend.1day.UAS	10 (seconds)	0 - 86400
DS3I.pmthresholds.line.nearend.15min.CV	387 (BPV count)	0 - 38700
DS3I.pmthresholds.line.nearend.15min.ES	25 (seconds)	0 - 900
DS3I.pmthresholds.line.nearend.15min.LOSS	10 (seconds)	0 - 900
DS3I.pmthresholds.line.nearend.15min.SES	4 (seconds)	0 - 900
DS3I.pmthresholds.line.nearend.1day.CV	3865 (BPV count)	0 - 3715200
DS3I.pmthresholds.line.nearend.1day.ES	250 (seconds)	0 - 86400
DS3I.pmthresholds.line.nearend.1day.LOSS	10 (seconds)	0 - 86400
DS3I.pmthresholds.line.nearend.1day.SES	40 (seconds)	0 - 86400
DS3I.pmthresholds.pbitpath.nearend.15min.AISS	10 (seconds)	0 - 900
DS3I.pmthresholds.pbitpath.nearend.15min.CV	382 (count)	0 - 287100
DS3I.pmthresholds.pbitpath.nearend.15min.ES	25 (seconds)	0 - 900
DS3I.pmthresholds.pbitpath.nearend.15min.SAS	2 (seconds)	0 - 900
DS3I.pmthresholds.pbitpath.nearend.15min.SES	4 (seconds)	0 - 900
DS3I.pmthresholds.pbitpath.nearend.15min.UAS	10 (seconds)	0 - 900
DS3I.pmthresholds.pbitpath.nearend.1day.AISS	10 (seconds)	0 - 86400
DS3I.pmthresholds.pbitpath.nearend.1day.CV	3820 (count)	0 - 27561600

Table C-4 DS3i-N-12 Card Default Settings (continued)

Default Name	Default Value	Default Domain
DS3I.pmthresholds.pbitpath.nearend.1day.ES	250 (seconds)	0 - 86400
DS3I.pmthresholds.pbitpath.nearend.1day.SAS	8 (seconds)	0 - 86400
DS3I.pmthresholds.pbitpath.nearend.1day.SES	40 (seconds)	0 - 86400
DS3I.pmthresholds.pbitpath.nearend.1day.UAS	10 (seconds)	0 - 86400
DS3I.pmthresholds.vc4.farend.15min.BBE	25 (count)	0 - 2159100
DS3I.pmthresholds.vc4.farend.15min.EB	15 (count)	0 - 7200000
DS3I.pmthresholds.vc4.farend.15min.ES	12 (seconds)	0 - 900
DS3I.pmthresholds.vc4.farend.15min.SES	3 (seconds)	0 - 900
DS3I.pmthresholds.vc4.farend.15min.UAS	10 (seconds)	0 - 900
DS3I.pmthresholds.vc4.farend.1day.BBE	250 (count)	0 - 207273600
DS3I.pmthresholds.vc4.farend.1day.EB	125 (count)	0 - 691200000
DS3I.pmthresholds.vc4.farend.1day.ES	100 (seconds)	0 - 86400
DS3I.pmthresholds.vc4.farend.1day.SES	7 (seconds)	0 - 86400
DS3I.pmthresholds.vc4.farend.1day.UAS	10 (seconds)	0 - 86400
DS3I.pmthresholds.vc4.nearend.15min.BBE	25 (count)	0 - 2159100
DS3I.pmthresholds.vc4.nearend.15min.EB	15 (count)	0 - 7200000
DS3I.pmthresholds.vc4.nearend.15min.ES	12 (seconds)	0 - 900
DS3I.pmthresholds.vc4.nearend.15min.SES	3 (seconds)	0 - 900
DS3I.pmthresholds.vc4.nearend.15min.UAS	10 (seconds)	0 - 900
DS3I.pmthresholds.vc4.nearend.1day.BBE	250 (count)	0 - 207273600
DS3I.pmthresholds.vc4.nearend.1day.EB	125 (count)	0 - 691200000
DS3I.pmthresholds.vc4.nearend.1day.ES	100 (seconds)	0 - 86400
DS3I.pmthresholds.vc4.nearend.1day.SES	7 (seconds)	0 - 86400
DS3I.pmthresholds.vc4.nearend.1day.UAS	10 (seconds)	0 - 86400
DS3I.pmthresholds.vclo.farend.15min.BBE	15 (count)	0 - 2159100
DS3I.pmthresholds.vclo.farend.15min.EB	15 (count)	0 - 7200000
DS3I.pmthresholds.vclo.farend.15min.ES	12 (seconds)	0 - 900
DS3I.pmthresholds.vclo.farend.15min.SES	3 (seconds)	0 - 900
DS3I.pmthresholds.vclo.farend.15min.UAS	10 (seconds)	0 - 900
DS3I.pmthresholds.vclo.farend.1day.BBE	150 (count)	0 - 207273600
DS3I.pmthresholds.vclo.farend.1day.EB	125 (count)	0 - 691200000
DS3I.pmthresholds.vclo.farend.1day.ES	100 (seconds)	0 - 86400
DS3I.pmthresholds.vclo.farend.1day.SES	7 (seconds)	0 - 86400
DS3I.pmthresholds.vclo.farend.1day.UAS	10 (seconds)	0 - 86400
DS3I.pmthresholds.vclo.nearend.15min.BBE	15 (count)	0 - 2159100
DS3I.pmthresholds.vclo.nearend.15min.EB	15 (count)	0 - 7200000

Table C-4 DS3i-N-12 Card Default Settings (continued)

Default Name	Default Value	Default Domain
DS3I.pmthresholds.vclo.nearend.15min.ES	12 (seconds)	0 - 900
DS3I.pmthresholds.vclo.nearend.15min.SES	3 (seconds)	0 - 900
DS3I.pmthresholds.vclo.nearend.15min.UAS	10 (seconds)	0 - 900
DS3I.pmthresholds.vclo.nearend.1day.BBE	150 (count)	0 - 207273600
DS3I.pmthresholds.vclo.nearend.1day.EB	125 (count)	0 - 691200000
DS3I.pmthresholds.vclo.nearend.1day.ES	100 (seconds)	0 - 86400
DS3I.pmthresholds.vclo.nearend.1day.SES	7 (seconds)	0 - 86400
DS3I.pmthresholds.vclo.nearend.1day.UAS	10 (seconds)	0 - 86400

C.2.3.5 STM1E-12 Card Default Settings

Table C-5 lists the STM1E-12 card default settings.

Table C-5 STM1E-12 Card Default Settings

Default Name	Default Value	Default Domain
STM1E-12.config.line.AdminSSMIn	STU	G811, STU, G812T, G812L, SETS, DUS
STM1E-12.config.line.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
STM1E-12.config.line.PJVC4Mon#	0 (VC4 #)	0 - 1
STM1E-12.config.line.SDBER	1.00E-07	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
STM1E-12.config.line.Send<FF>DoNotUse	FALSE	FALSE when SendDoNotUse TRUE; FALSE, TRUE when SendDoNotUse FALSE
STM1E-12.config.line.SendDoNotUse	FALSE	FALSE, TRUE
STM1E-12.config.line.SFBER	1.00E-04	1E-3, 1E-4, 1E-5
STM1E-12.config.line.State	unlocked, automaticInServic e	unlocked, locked, disabled, locked, maintenance, unlocked, automaticInService
STM1E-12.config.line.SyncMsgIn	TRUE	FALSE, TRUE
STM1E-12.config.vc4.IPPMEnabled	FALSE	TRUE, FALSE
STM1E-12.pmthresholds.ms.farend.15min.BBE	1312 (count)	0 - 137700
STM1E-12.pmthresholds.ms.farend.15min.EB	1312 (count)	0 - 137700
STM1E-12.pmthresholds.ms.farend.15min.ES	87 (seconds)	0 - 900
STM1E-12.pmthresholds.ms.farend.15min.SES	1 (seconds)	0 - 900
STM1E-12.pmthresholds.ms.farend.15min.UAS	3 (seconds)	0 - 900
STM1E-12.pmthresholds.ms.farend.1day.BBE	13120 (count)	0 - 13219200
STM1E-12.pmthresholds.ms.farend.1day.EB	13120 (count)	0 - 13219200
STM1E-12.pmthresholds.ms.farend.1day.ES	864 (seconds)	0 - 86400
STM1E-12.pmthresholds.ms.farend.1day.SES	4 (seconds)	0 - 86400

Table C-5 STM1E-12 Card Default Settings (continued)

Default Name	Default Value	Default Domain
STM1E-12.pmthresholds.ms.farend.1day.UAS	10 (seconds)	0 - 86400
STM1E-12.pmthresholds.ms.nearend.15min.BBE	1312 (count)	0 - 137700
STM1E-12.pmthresholds.ms.nearend.15min.EB	1312 (count)	0 - 137700
STM1E-12.pmthresholds.ms.nearend.15min.ES	87 (seconds)	0 - 900
STM1E-12.pmthresholds.ms.nearend.15min.SES	1 (seconds)	0 - 900
STM1E-12.pmthresholds.ms.nearend.15min.UAS	3 (seconds)	0 - 900
STM1E-12.pmthresholds.ms.nearend.1day.BBE	13120 (count)	0 - 13219200
STM1E-12.pmthresholds.ms.nearend.1day.EB	13120 (count)	0 - 13219200
STM1E-12.pmthresholds.ms.nearend.1day.ES	864 (seconds)	0 - 86400
STM1E-12.pmthresholds.ms.nearend.1day.SES	4 (seconds)	0 - 86400
STM1E-12.pmthresholds.ms.nearend.1day.UAS	10 (seconds)	0 - 86400
STM1E-12.pmthresholds.path.nearend.15min.BBE	25 (count)	0 - 2159100
STM1E-12.pmthresholds.path.nearend.15min.EB	15 (count)	0 - 7200000
STM1E-12.pmthresholds.path.nearend.15min.ES	12 (seconds)	0 - 900
STM1E-12.pmthresholds.path.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
STM1E-12.pmthresholds.path.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
STM1E-12.pmthresholds.path.nearend.15min.PJCDIFF	60 (count)	0 - 14400000
STM1E-12.pmthresholds.path.nearend.15min.PJCS-PDET	100 (seconds)	0 - 900
STM1E-12.pmthresholds.path.nearend.15min.PJCS-PGEN	100 (seconds)	0 - 900
STM1E-12.pmthresholds.path.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
STM1E-12.pmthresholds.path.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
STM1E-12.pmthresholds.path.nearend.15min.SES	3 (seconds)	0 - 900
STM1E-12.pmthresholds.path.nearend.15min.UAS	10 (seconds)	0 - 900
STM1E-12.pmthresholds.path.nearend.1day.BBE	250 (count)	0 - 207273600
STM1E-12.pmthresholds.path.nearend.1day.EB	125 (count)	0 - 691200000
STM1E-12.pmthresholds.path.nearend.1day.ES	100 (seconds)	0 - 86400
STM1E-12.pmthresholds.path.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
STM1E-12.pmthresholds.path.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
STM1E-12.pmthresholds.path.nearend.1day.PJCDIFF	5760 (count)	0 - 1382400000
STM1E-12.pmthresholds.path.nearend.1day.PJCS-PDET	9600 (seconds)	0 - 86400
STM1E-12.pmthresholds.path.nearend.1day.PJCS-PGEN	9600 (seconds)	0 - 86400
STM1E-12.pmthresholds.path.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
STM1E-12.pmthresholds.path.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
STM1E-12.pmthresholds.path.nearend.1day.SES	7 (seconds)	0 - 86400
STM1E-12.pmthresholds.path.nearend.1day.UAS	10 (seconds)	0 - 86400
STM1E-12.pmthresholds.rs.nearend.15min.BBE	10000 (count)	0 - 138600

Table C-5 STM1E-12 Card Default Settings (continued)

Default Name	Default Value	Default Domain
STM1E-12.pmthresholds.rs.nearend.15min.EB	10000 (count)	0 - 138600
STM1E-12.pmthresholds.rs.nearend.15min.ES	500 (seconds)	0 - 900
STM1E-12.pmthresholds.rs.nearend.15min.SEFS	500 (seconds)	0 - 900
STM1E-12.pmthresholds.rs.nearend.15min.SES	500 (seconds)	0 - 900
STM1E-12.pmthresholds.rs.nearend.15min.UAS	3 (seconds)	0 - 900
STM1E-12.pmthresholds.rs.nearend.1day.BBE	100000 (count)	0 - 13305600
STM1E-12.pmthresholds.rs.nearend.1day.EB	100000 (count)	0 - 13305600
STM1E-12.pmthresholds.rs.nearend.1day.ES	5000 (seconds)	0 - 86400
STM1E-12.pmthresholds.rs.nearend.1day.SEFS	5000 (seconds)	0 - 86400
STM1E-12.pmthresholds.rs.nearend.1day.SES	5000 (seconds)	0 - 86400
STM1E-12.pmthresholds.rs.nearend.1day.UAS	10 (seconds)	0 - 86400

C.2.3.6 Ethernet Card Default Settings

Table C-6 lists the CE-100T-8, G1000 (G1K-4), ML-100T-12, ML-100X-8, and ML-1000-2 card default settings.

Table C-6 Ethernet Card Default Settings

Default Name	Default Value	Default Domain
CE-1000-4.config.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
CE-1000-4.config.State	locked, disabled	unlocked, locked, disabled, locked, maintenance, unlocked, automaticInService
CE-1000-4.etherPortConfig.AutoNegotiation	TRUE	TRUE, FALSE
CE-1000-4.etherPortConfig.FlowControl	Symmetric	None, Symmetric, Pass Through
CE-1000-4.etherPortConfig.MTU	10004 (bytes)	1548, 10004
CE-1000-4.posPortConfig.FramingType	GFP-F	HDLC, GFP-F
CE-100T-8.config.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
CE-100T-8.config.State	locked, disabled	unlocked, locked, disabled, locked, maintenance, unlocked, automaticInService
CE-100T-8.etherPortConfig.802-1Q-VlanCoS	7 (count)	0 - 7
CE-100T-8.etherPortConfig.IP-ToS	255 (count)	0 - 255
G1000.config.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
G1000.config.State	locked, disabled	unlocked, locked, disabled, locked, maintenance, unlocked, automaticInService
ML1000.config.card.Mode	HDLC	HDLC, GFP-F
ML1000.ios.consolePortAccess	TRUE	TRUE, FALSE
ML1000.ios.radiusServerAccess	FALSE	TRUE, FALSE
ML100T.config.card.Mode	HDLC	HDLC, GFP-F

Table C-6 Ethernet Card Default Settings (continued)

Default Name	Default Value	Default Domain
ML100T.ios.consolePortAccess	TRUE	TRUE, FALSE
ML100T.ios.radiusServerAccess	FALSE	TRUE, FALSE
ML100X-8.config.card.Mode	HDLC	HDLC, GFP-F
ML100X-8.ios.consolePortAccess	TRUE	TRUE, FALSE
ML100X-8.ios.radiusServerAccess	FALSE	TRUE, FALSE

C.2.3.7 STM-1 Card Default Settings

Table C-7 lists the STM-1 card default settings.

Table C-7 STM-1 Card Default Settings

Default Name	Default Value	Default Domain
STM1.config.line.AdminSSMIn	STU	G811, STU, G812T, G812L, SETS, DUS
STM1.config.line.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
STM1.config.line.PJVC4Mon#	0 (VC4 #)	0 - 1
STM1.config.line.SDBER	1.00E-07	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
STM1.config.line.Send<FF>DoNotUse	FALSE	FALSE when SendDoNotUse TRUE; FALSE, TRUE when SendDoNotUse FALSE
STM1.config.line.SendDoNotUse	FALSE	FALSE, TRUE
STM1.config.line.SFBER	1.00E-04	1E-3, 1E-4, 1E-5
STM1.config.line.State	unlocked, automaticInService	unlocked, locked, disabled, locked, maintenance, unlocked, automaticInService
STM1.config.line.SyncMsgIn	TRUE	FALSE, TRUE
STM1.config.vc4.IPPMEnabled	FALSE	TRUE, FALSE
STM1.pmthresholds.ms.farend.15min.BBE	1312 (count)	0 - 137700
STM1.pmthresholds.ms.farend.15min.EB	1312 (count)	0 - 137700
STM1.pmthresholds.ms.farend.15min.ES	87 (seconds)	0 - 900
STM1.pmthresholds.ms.farend.15min.SES	1 (seconds)	0 - 900
STM1.pmthresholds.ms.farend.15min.UAS	3 (seconds)	0 - 900
STM1.pmthresholds.ms.farend.1day.BBE	13120 (count)	0 - 13219200
STM1.pmthresholds.ms.farend.1day.EB	13120 (count)	0 - 13219200
STM1.pmthresholds.ms.farend.1day.ES	864 (seconds)	0 - 86400
STM1.pmthresholds.ms.farend.1day.SES	4 (seconds)	0 - 86400
STM1.pmthresholds.ms.farend.1day.UAS	10 (seconds)	0 - 86400
STM1.pmthresholds.ms.nearend.15min.BBE	1312 (count)	0 - 137700
STM1.pmthresholds.ms.nearend.15min.EB	1312 (count)	0 - 137700
STM1.pmthresholds.ms.nearend.15min.ES	87 (seconds)	0 - 900

Table C-7 STM-1 Card Default Settings (continued)

Default Name	Default Value	Default Domain
STM1.pmthresholds.ms.nearend.15min.PSC	1 (count)	0 - 600
STM1.pmthresholds.ms.nearend.15min.PSD	300 (seconds)	0 - 900
STM1.pmthresholds.ms.nearend.15min.SES	1 (seconds)	0 - 900
STM1.pmthresholds.ms.nearend.15min.UAS	3 (seconds)	0 - 900
STM1.pmthresholds.ms.nearend.1day.BBE	13120 (count)	0 - 13219200
STM1.pmthresholds.ms.nearend.1day.EB	13120 (count)	0 - 13219200
STM1.pmthresholds.ms.nearend.1day.ES	864 (seconds)	0 - 86400
STM1.pmthresholds.ms.nearend.1day.PSC	5 (count)	0 - 57600
STM1.pmthresholds.ms.nearend.1day.PSD	600 (seconds)	0 - 86400
STM1.pmthresholds.ms.nearend.1day.SES	4 (seconds)	0 - 86400
STM1.pmthresholds.ms.nearend.1day.UAS	10 (seconds)	0 - 86400
STM1.pmthresholds.path.farend.15min.BBE	25 (count)	0 - 2159100
STM1.pmthresholds.path.farend.15min.EB	15 (count)	0 - 13305600
STM1.pmthresholds.path.farend.15min.ES	12 (seconds)	0 - 900
STM1.pmthresholds.path.farend.15min.SES	3 (seconds)	0 - 900
STM1.pmthresholds.path.farend.15min.UAS	10 (seconds)	0 - 900
STM1.pmthresholds.path.farend.1day.BBE	250 (count)	0 - 207273600
STM1.pmthresholds.path.farend.1day.EB	125 (count)	0 - 691200000
STM1.pmthresholds.path.farend.1day.ES	100 (seconds)	0 - 86400
STM1.pmthresholds.path.farend.1day.SES	7 (seconds)	0 - 86400
STM1.pmthresholds.path.farend.1day.UAS	10 (seconds)	0 - 86400
STM1.pmthresholds.path.nearend.15min.BBE	25 (count)	0 - 2159100
STM1.pmthresholds.path.nearend.15min.EB	15 (count)	0 - 7200000
STM1.pmthresholds.path.nearend.15min.ES	12 (seconds)	0 - 900
STM1.pmthresholds.path.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
STM1.pmthresholds.path.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
STM1.pmthresholds.path.nearend.15min.PJCDIFF	60 (count)	0 - 14400000
STM1.pmthresholds.path.nearend.15min.PJCS-PDET	100 (seconds)	0 - 900
STM1.pmthresholds.path.nearend.15min.PJCS-PGEN	100 (seconds)	0 - 900
STM1.pmthresholds.path.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
STM1.pmthresholds.path.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
STM1.pmthresholds.path.nearend.15min.SES	3 (seconds)	0 - 900
STM1.pmthresholds.path.nearend.15min.UAS	10 (seconds)	0 - 900
STM1.pmthresholds.path.nearend.1day.BBE	250 (count)	0 - 207273600
STM1.pmthresholds.path.nearend.1day.EB	125 (count)	0 - 691200000
STM1.pmthresholds.path.nearend.1day.ES	100 (seconds)	0 - 86400

Table C-7 STM-1 Card Default Settings (continued)

Default Name	Default Value	Default Domain
STM1.pmthresholds.path.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
STM1.pmthresholds.path.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
STM1.pmthresholds.path.nearend.1day.PJCDIFF	5760 (count)	0 - 1382400000
STM1.pmthresholds.path.nearend.1day.PJCS-PDET	9600 (seconds)	0 - 86400
STM1.pmthresholds.path.nearend.1day.PJCS-PGEN	9600 (seconds)	0 - 86400
STM1.pmthresholds.path.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
STM1.pmthresholds.path.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
STM1.pmthresholds.path.nearend.1day.SES	7 (seconds)	0 - 86400
STM1.pmthresholds.path.nearend.1day.UAS	10 (seconds)	0 - 86400
STM1.pmthresholds.rs.nearend.15min.BBE	10000 (count)	0 - 138600
STM1.pmthresholds.rs.nearend.15min.EB	10000 (count)	0 - 138600
STM1.pmthresholds.rs.nearend.15min.ES	500 (seconds)	0 - 900
STM1.pmthresholds.rs.nearend.15min.SEFS	500 (seconds)	0 - 900
STM1.pmthresholds.rs.nearend.15min.SES	500 (seconds)	0 - 900
STM1.pmthresholds.rs.nearend.15min.UAS	3 (seconds)	0 - 900
STM1.pmthresholds.rs.nearend.1day.BBE	100000 (count)	0 - 13305600
STM1.pmthresholds.rs.nearend.1day.EB	100000 (count)	0 - 13305600
STM1.pmthresholds.rs.nearend.1day.ES	5000 (seconds)	0 - 86400
STM1.pmthresholds.rs.nearend.1day.SEFS	5000 (seconds)	0 - 86400
STM1.pmthresholds.rs.nearend.1day.SES	5000 (seconds)	0 - 86400
STM1.pmthresholds.rs.nearend.1day.UAS	10 (seconds)	0 - 86400

C.2.3.8 STM1-8 Card Default Settings

Table C-8 lists the STM1-8 card default settings.

Table C-8 STM1-8 Card Default Settings

Default Name	Default Value	Default Domain
STM1-8.config.line.AdminSSMIn	STU	G811, STU, G812T, G812L, SETS, DUS
STM1-8.config.line.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
STM1-8.config.line.AlsMode	Disabled	Disabled, Auto Restart, Manual Restart, Manual Restart for Test
STM1-8.config.line.AlsRecoveryPulseDuration	2.0 (seconds)	2.0, 2.1, 2.2 .. 100.0 when AlsMode Disabled, Auto Restart, Manual Restart; 80.0, 80.1, 80.2 .. 100.0 when AlsMode Manual Restart for Test
STM1-8.config.line.AlsRecoveryPulseInterval	100 (seconds)	60 - 300
STM1-8.config.line.PJVC4Mon#	0 (VC4 #)	0 - 1

Table C-8 STM1-8 Card Default Settings (continued)

Default Name	Default Value	Default Domain
STM1-8.config.line.SDBER	1.00E-07	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
STM1-8.config.line.Send<FF>DoNotUse	FALSE	FALSE when SendDoNotUse TRUE; FALSE, TRUE when SendDoNotUse FALSE
STM1-8.config.line.SendDoNotUse	FALSE	FALSE, TRUE
STM1-8.config.line.SFBER	1.00E-04	1E-3, 1E-4, 1E-5
STM1-8.config.line.State	unlocked, automaticInService	unlocked, locked, disabled, locked, maintenance, unlocked, automaticInService
STM1-8.config.line.SyncMsgIn	TRUE	FALSE, TRUE
STM1-8.config.vc4.IPPMEnabled	FALSE	TRUE, FALSE
STM1-8.physicalthresholds.alarm.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1.0, LBC-LOW + 2.0 .. 255.0
STM1-8.physicalthresholds.alarm.LBC-LOW	20 (%)	0.0, 1.0, 2.0 .. LBC-HIGH
STM1-8.physicalthresholds.alarm.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1.0, OPR-LOW + 2.0 .. 255.0
STM1-8.physicalthresholds.alarm.OPR-LOW	50 (%)	-1.0, 0.0, 1.0 .. OPR-HIGH
STM1-8.physicalthresholds.alarm.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1.0, OPT-LOW + 2.0 .. 255.0
STM1-8.physicalthresholds.alarm.OPT-LOW	80 (%)	0.0, 1.0, 2.0 .. OPT-HIGH
STM1-8.physicalthresholds.warning.15min.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1.0, LBC-LOW + 2.0 .. 255.0
STM1-8.physicalthresholds.warning.15min.LBC-LOW	20 (%)	0.0, 1.0, 2.0 .. LBC-HIGH
STM1-8.physicalthresholds.warning.15min.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1.0, OPR-LOW + 2.0 .. 255.0
STM1-8.physicalthresholds.warning.15min.OPR-LOW	50 (%)	-1.0, 0.0, 1.0 .. OPR-HIGH
STM1-8.physicalthresholds.warning.15min.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1.0, OPT-LOW + 2.0 .. 255.0
STM1-8.physicalthresholds.warning.15min.OPT-LOW	80 (%)	0.0, 1.0, 2.0 .. OPT-HIGH
STM1-8.physicalthresholds.warning.1day.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1.0, LBC-LOW + 2.0 .. 255.0
STM1-8.physicalthresholds.warning.1day.LBC-LOW	20 (%)	0.0, 1.0, 2.0 .. LBC-HIGH
STM1-8.physicalthresholds.warning.1day.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1.0, OPR-LOW + 2.0 .. 255.0
STM1-8.physicalthresholds.warning.1day.OPR-LOW	50 (%)	-1.0, 0.0, 1.0 .. OPR-HIGH
STM1-8.physicalthresholds.warning.1day.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1.0, OPT-LOW + 2.0 .. 255.0
STM1-8.physicalthresholds.warning.1day.OPT-LOW	80 (%)	0.0, 1.0, 2.0 .. OPT-HIGH
STM1-8.pmthresholds.ms.farend.15min.BBE	1312 (count)	0 - 137700
STM1-8.pmthresholds.ms.farend.15min.EB	1312 (count)	0 - 137700

Table C-8 STM1-8 Card Default Settings (continued)

Default Name	Default Value	Default Domain
STM1-8.pmthresholds.ms.farend.15min.ES	87 (seconds)	0 - 900
STM1-8.pmthresholds.ms.farend.15min.SES	1 (seconds)	0 - 900
STM1-8.pmthresholds.ms.farend.15min.UAS	3 (seconds)	0 - 900
STM1-8.pmthresholds.ms.farend.1day.BBE	13120 (count)	0 - 13219200
STM1-8.pmthresholds.ms.farend.1day.EB	13120 (count)	0 - 13219200
STM1-8.pmthresholds.ms.farend.1day.ES	864 (seconds)	0 - 86400
STM1-8.pmthresholds.ms.farend.1day.SES	4 (seconds)	0 - 86400
STM1-8.pmthresholds.ms.farend.1day.UAS	10 (seconds)	0 - 86400
STM1-8.pmthresholds.ms.nearend.15min.BBE	1312 (count)	0 - 137700
STM1-8.pmthresholds.ms.nearend.15min.EB	1312 (count)	0 - 137700
STM1-8.pmthresholds.ms.nearend.15min.ES	87 (seconds)	0 - 900
STM1-8.pmthresholds.ms.nearend.15min.PSC	1 (count)	0 - 600
STM1-8.pmthresholds.ms.nearend.15min.PSD	300 (seconds)	0 - 900
STM1-8.pmthresholds.ms.nearend.15min.SES	1 (seconds)	0 - 900
STM1-8.pmthresholds.ms.nearend.15min.UAS	3 (seconds)	0 - 900
STM1-8.pmthresholds.ms.nearend.1day.BBE	13120 (count)	0 - 13219200
STM1-8.pmthresholds.ms.nearend.1day.EB	13120 (count)	0 - 13219200
STM1-8.pmthresholds.ms.nearend.1day.ES	864 (seconds)	0 - 86400
STM1-8.pmthresholds.ms.nearend.1day.PSC	5 (count)	0 - 57600
STM1-8.pmthresholds.ms.nearend.1day.PSD	600 (seconds)	0 - 86400
STM1-8.pmthresholds.ms.nearend.1day.SES	4 (seconds)	0 - 86400
STM1-8.pmthresholds.ms.nearend.1day.UAS	10 (seconds)	0 - 86400
STM1-8.pmthresholds.path.farend.15min.BBE	25 (count)	0 - 2159100
STM1-8.pmthresholds.path.farend.15min.EB	15 (count)	0 - 13305600
STM1-8.pmthresholds.path.farend.15min.ES	12 (seconds)	0 - 900
STM1-8.pmthresholds.path.farend.15min.SES	3 (seconds)	0 - 900
STM1-8.pmthresholds.path.farend.15min.UAS	10 (seconds)	0 - 900
STM1-8.pmthresholds.path.farend.1day.BBE	250 (count)	0 - 207273600
STM1-8.pmthresholds.path.farend.1day.EB	125 (count)	0 - 691200000
STM1-8.pmthresholds.path.farend.1day.ES	100 (seconds)	0 - 86400
STM1-8.pmthresholds.path.farend.1day.SES	7 (seconds)	0 - 86400
STM1-8.pmthresholds.path.farend.1day.UAS	10 (seconds)	0 - 86400
STM1-8.pmthresholds.path.nearend.15min.BBE	25 (count)	0 - 2159100
STM1-8.pmthresholds.path.nearend.15min.EB	15 (count)	0 - 7200000
STM1-8.pmthresholds.path.nearend.15min.ES	12 (seconds)	0 - 900
STM1-8.pmthresholds.path.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000

Table C-8 STM1-8 Card Default Settings (continued)

Default Name	Default Value	Default Domain
STM1-8.pmthresholds.path.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
STM1-8.pmthresholds.path.nearend.15min.PJCDIFF	60 (count)	0 - 14400000
STM1-8.pmthresholds.path.nearend.15min.PJCS-PDET	100 (seconds)	0 - 900
STM1-8.pmthresholds.path.nearend.15min.PJCS-PGEN	100 (seconds)	0 - 900
STM1-8.pmthresholds.path.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
STM1-8.pmthresholds.path.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
STM1-8.pmthresholds.path.nearend.15min.SES	3 (seconds)	0 - 900
STM1-8.pmthresholds.path.nearend.15min.UAS	10 (seconds)	0 - 900
STM1-8.pmthresholds.path.nearend.1day.BBE	250 (count)	0 - 207273600
STM1-8.pmthresholds.path.nearend.1day.EB	125 (count)	0 - 691200000
STM1-8.pmthresholds.path.nearend.1day.ES	100 (seconds)	0 - 86400
STM1-8.pmthresholds.path.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
STM1-8.pmthresholds.path.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
STM1-8.pmthresholds.path.nearend.1day.PJCDIFF	5760 (count)	0 - 1382400000
STM1-8.pmthresholds.path.nearend.1day.PJCS-PDET	9600 (seconds)	0 - 86400
STM1-8.pmthresholds.path.nearend.1day.PJCS-PGEN	9600 (seconds)	0 - 86400
STM1-8.pmthresholds.path.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
STM1-8.pmthresholds.path.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
STM1-8.pmthresholds.path.nearend.1day.SES	7 (seconds)	0 - 86400
STM1-8.pmthresholds.path.nearend.1day.UAS	10 (seconds)	0 - 86400
STM1-8.pmthresholds.rs.nearend.15min.BBE	10000 (count)	0 - 138600
STM1-8.pmthresholds.rs.nearend.15min.EB	10000 (count)	0 - 138600
STM1-8.pmthresholds.rs.nearend.15min.ES	500 (seconds)	0 - 900
STM1-8.pmthresholds.rs.nearend.15min.SEFS	500 (seconds)	0 - 900
STM1-8.pmthresholds.rs.nearend.15min.SES	500 (seconds)	0 - 900
STM1-8.pmthresholds.rs.nearend.15min.UAS	3 (seconds)	0 - 900
STM1-8.pmthresholds.rs.nearend.1day.BBE	100000 (count)	0 - 13305600
STM1-8.pmthresholds.rs.nearend.1day.EB	100000 (count)	0 - 13305600
STM1-8.pmthresholds.rs.nearend.1day.ES	5000 (seconds)	0 - 86400
STM1-8.pmthresholds.rs.nearend.1day.SEFS	5000 (seconds)	0 - 86400
STM1-8.pmthresholds.rs.nearend.1day.SES	5000 (seconds)	0 - 86400
STM1-8.pmthresholds.rs.nearend.1day.UAS	10 (seconds)	0 - 86400

C.2.3.9 STM-4 Card Default Settings

Table C-9 lists the STM-4 card default settings.

Table C-9 STM-4 Card Default Settings

Default Name	Default Value	Default Domain
STM4.config.line.AdminSSMIn	STU	G811, STU, G812T, G812L, SETS, DUS
STM4.config.line.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
STM4.config.line.PJVC4Mon#	0 (VC4 #)	0 - 4
STM4.config.line.SDBER	1.00E-07	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
STM4.config.line.Send<FF>DoNotUse	FALSE	FALSE when SendDoNotUse TRUE; FALSE, TRUE when SendDoNotUse FALSE
STM4.config.line.SendDoNotUse	FALSE	FALSE, TRUE
STM4.config.line.SFBER	1.00E-04	1E-3, 1E-4, 1E-5
STM4.config.line.State	unlocked, automaticInService	unlocked, locked, disabled, locked, maintenance, unlocked, automaticInService
STM4.config.line.SyncMsgIn	TRUE	FALSE, TRUE
STM4.config.vc4.IPPMEnabled	FALSE	TRUE, FALSE
STM4.pmthresholds.ms.farend.15min.BBE	5315 (count)	0 - 552600
STM4.pmthresholds.ms.farend.15min.EB	5315 (count)	0 - 552600
STM4.pmthresholds.ms.farend.15min.ES	87 (seconds)	0 - 900
STM4.pmthresholds.ms.farend.15min.SES	1 (seconds)	0 - 900
STM4.pmthresholds.ms.farend.15min.UAS	3 (seconds)	0 - 900
STM4.pmthresholds.ms.farend.1day.BBE	53150 (count)	0 - 53049600
STM4.pmthresholds.ms.farend.1day.EB	53150 (count)	0 - 53049600
STM4.pmthresholds.ms.farend.1day.ES	864 (seconds)	0 - 86400
STM4.pmthresholds.ms.farend.1day.SES	4 (seconds)	0 - 900
STM4.pmthresholds.ms.farend.1day.UAS	10 (seconds)	0 - 86400
STM4.pmthresholds.ms.nearend.15min.BBE	5315 (count)	0 - 552600
STM4.pmthresholds.ms.nearend.15min.EB	5315 (count)	0 - 552600
STM4.pmthresholds.ms.nearend.15min.ES	87 (seconds)	0 - 900
STM4.pmthresholds.ms.nearend.15min.PSC	1 (count)	0 - 600
STM4.pmthresholds.ms.nearend.15min.PSC-W	1 (count)	0 - 600
STM4.pmthresholds.ms.nearend.15min.PSD	300 (seconds)	0 - 900
STM4.pmthresholds.ms.nearend.15min.PSD-W	300 (seconds)	0 - 900
STM4.pmthresholds.ms.nearend.15min.SES	1 (seconds)	0 - 900
STM4.pmthresholds.ms.nearend.15min.UAS	3 (seconds)	0 - 900
STM4.pmthresholds.ms.nearend.1day.BBE	53150 (count)	0 - 53049600
STM4.pmthresholds.ms.nearend.1day.EB	53150 (count)	0 - 53049600

Table C-9 STM-4 Card Default Settings (continued)

Default Name	Default Value	Default Domain
STM4.pmthresholds.ms.nearend.1day.ES	864 (seconds)	0 - 86400
STM4.pmthresholds.ms.nearend.1day.PSC	5 (count)	0 - 57600
STM4.pmthresholds.ms.nearend.1day.PSC-W	5 (count)	0 - 57600
STM4.pmthresholds.ms.nearend.1day.PSD	600 (seconds)	0 - 86400
STM4.pmthresholds.ms.nearend.1day.PSD-W	600 (seconds)	0 - 86400
STM4.pmthresholds.ms.nearend.1day.SES	4 (seconds)	0 - 86400
STM4.pmthresholds.ms.nearend.1day.UAS	10 (seconds)	0 - 86400
STM4.pmthresholds.path.nearend.15min.BBE	25 (count)	0 - 2159100
STM4.pmthresholds.path.nearend.15min.EB	15 (count)	0 - 7200000
STM4.pmthresholds.path.nearend.15min.ES	12 (seconds)	0 - 900
STM4.pmthresholds.path.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
STM4.pmthresholds.path.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
STM4.pmthresholds.path.nearend.15min.PJCDIFF	60 (count)	0 - 14400000
STM4.pmthresholds.path.nearend.15min.PJCS-PDET	100 (seconds)	0 - 900
STM4.pmthresholds.path.nearend.15min.PJCS-PGEN	100 (seconds)	0 - 900
STM4.pmthresholds.path.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
STM4.pmthresholds.path.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
STM4.pmthresholds.path.nearend.15min.SES	3 (seconds)	0 - 900
STM4.pmthresholds.path.nearend.15min.UAS	10 (seconds)	0 - 900
STM4.pmthresholds.path.nearend.1day.BBE	250 (count)	0 - 207273600
STM4.pmthresholds.path.nearend.1day.EB	125 (count)	0 - 691200000
STM4.pmthresholds.path.nearend.1day.ES	100 (seconds)	0 - 86400
STM4.pmthresholds.path.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
STM4.pmthresholds.path.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
STM4.pmthresholds.path.nearend.1day.PJCDIFF	5760 (count)	0 - 1382400000
STM4.pmthresholds.path.nearend.1day.PJCS-PDET	9600 (seconds)	0 - 86400
STM4.pmthresholds.path.nearend.1day.PJCS-PGEN	9600 (seconds)	0 - 86400
STM4.pmthresholds.path.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
STM4.pmthresholds.path.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
STM4.pmthresholds.path.nearend.1day.SES	7 (seconds)	0 - 86400
STM4.pmthresholds.path.nearend.1day.UAS	10 (seconds)	0 - 86400
STM4.pmthresholds.rs.nearend.15min.BBE	10000 (count)	0 - 553500
STM4.pmthresholds.rs.nearend.15min.EB	10000 (count)	0 - 553500
STM4.pmthresholds.rs.nearend.15min.ES	500 (seconds)	0 - 900
STM4.pmthresholds.rs.nearend.15min.SEFS	500 (seconds)	0 - 900
STM4.pmthresholds.rs.nearend.15min.SES	500 (seconds)	0 - 900

Table C-9 STM-4 Card Default Settings (continued)

Default Name	Default Value	Default Domain
STM4.pmthresholds.rs.nearend.15min.UAS	3 (seconds)	0 - 900
STM4.pmthresholds.rs.nearend.1day.BBE	100000 (count)	0 - 53136000
STM4.pmthresholds.rs.nearend.1day.EB	100000 (count)	0 - 53136000
STM4.pmthresholds.rs.nearend.1day.ES	5000 (seconds)	0 - 86400
STM4.pmthresholds.rs.nearend.1day.SEFS	5000 (seconds)	0 - 86400
STM4.pmthresholds.rs.nearend.1day.SES	5000 (seconds)	0 - 86400
STM4.pmthresholds.rs.nearend.1day.UAS	10 (seconds)	0 - 86400

C.2.3.10 STM4-4 Card Default Settings

Table C-10 lists the STM4-4 card default settings.

Table C-10 STM4-4 Card Default Settings

Default Name	Default Value	Default Domain
STM4-4.config.line.AdminSSMIn	STU	G811, STU, G812T, G812L, SETS, DUS
STM4-4.config.line.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
STM4-4.config.line.PJVC4Mon#	0 (VC4 #)	0 - 4
STM4-4.config.line.SDBER	1.00E-07	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
STM4-4.config.line.Send<FF>DoNotUse	FALSE	FALSE when SendDoNotUse TRUE; FALSE, TRUE when SendDoNotUse FALSE
STM4-4.config.line.SendDoNotUse	FALSE	FALSE, TRUE
STM4-4.config.line.SFBER	1.00E-04	1E-3, 1E-4, 1E-5
STM4-4.config.line.State	unlocked, automaticInService	unlocked, locked, disabled, locked, maintenance, unlocked, automaticInService
STM4-4.config.line.SyncMsgIn	TRUE	FALSE, TRUE
STM4-4.config.vc4.IPPMEnabled	FALSE	TRUE, FALSE
STM4-4.pmthresholds.ms.farend.15min.BBE	5315 (count)	0 - 552600
STM4-4.pmthresholds.ms.farend.15min.EB	5315 (count)	0 - 552600
STM4-4.pmthresholds.ms.farend.15min.ES	87 (seconds)	0 - 900
STM4-4.pmthresholds.ms.farend.15min.SES	1 (seconds)	0 - 900
STM4-4.pmthresholds.ms.farend.15min.UAS	3 (seconds)	0 - 900
STM4-4.pmthresholds.ms.farend.1day.BBE	53150 (count)	0 - 53049600
STM4-4.pmthresholds.ms.farend.1day.EB	53150 (count)	0 - 53049600
STM4-4.pmthresholds.ms.farend.1day.ES	864 (seconds)	0 - 86400
STM4-4.pmthresholds.ms.farend.1day.SES	4 (seconds)	0 - 86400
STM4-4.pmthresholds.ms.farend.1day.UAS	10 (seconds)	0 - 86400

Table C-10 STM4-4 Card Default Settings (continued)

Default Name	Default Value	Default Domain
STM4-4.pmthresholds.ms.nearend.15min.BBE	5315 (count)	0 - 552600
STM4-4.pmthresholds.ms.nearend.15min.EB	5315 (count)	0 - 552600
STM4-4.pmthresholds.ms.nearend.15min.ES	87 (seconds)	0 - 900
STM4-4.pmthresholds.ms.nearend.15min.PSC	1 (count)	0 - 600
STM4-4.pmthresholds.ms.nearend.15min.PSC-W	1 (count)	0 - 600
STM4-4.pmthresholds.ms.nearend.15min.PSD	300 (seconds)	0 - 900
STM4-4.pmthresholds.ms.nearend.15min.PSD-W	300 (seconds)	0 - 900
STM4-4.pmthresholds.ms.nearend.15min.SES	1 (seconds)	0 - 900
STM4-4.pmthresholds.ms.nearend.15min.UAS	3 (seconds)	0 - 900
STM4-4.pmthresholds.ms.nearend.1day.BBE	53150 (count)	0 - 53049600
STM4-4.pmthresholds.ms.nearend.1day.EB	53150 (count)	0 - 53049600
STM4-4.pmthresholds.ms.nearend.1day.ES	864 (seconds)	0 - 86400
STM4-4.pmthresholds.ms.nearend.1day.PSC	5 (count)	0 - 57600
STM4-4.pmthresholds.ms.nearend.1day.PSC-W	5 (count)	0 - 57600
STM4-4.pmthresholds.ms.nearend.1day.PSD	600 (seconds)	0 - 86400
STM4-4.pmthresholds.ms.nearend.1day.PSD-W	600 (seconds)	0 - 86400
STM4-4.pmthresholds.ms.nearend.1day.SES	4 (seconds)	0 - 86400
STM4-4.pmthresholds.ms.nearend.1day.UAS	10 (seconds)	0 - 86400
STM4-4.pmthresholds.path.nearend.15min.BBE	25 (count)	0 - 2159100
STM4-4.pmthresholds.path.nearend.15min.EB	15 (count)	0 - 7200000
STM4-4.pmthresholds.path.nearend.15min.ES	12 (seconds)	0 - 900
STM4-4.pmthresholds.path.nearend.15min.NPJC-PDET	60 (count)	0 - 691200000
STM4-4.pmthresholds.path.nearend.15min.NPJC-PGEN	60 (count)	0 - 691200000
STM4-4.pmthresholds.path.nearend.15min.PJCDIFF	60 (count)	0 - 14400000
STM4-4.pmthresholds.path.nearend.15min.PJCS-PDET	100 (seconds)	0 - 900
STM4-4.pmthresholds.path.nearend.15min.PJCS-PGEN	100 (seconds)	0 - 900
STM4-4.pmthresholds.path.nearend.15min.PPJC-PDET	60 (count)	0 - 691200000
STM4-4.pmthresholds.path.nearend.15min.PPJC-PGEN	60 (count)	0 - 691200000
STM4-4.pmthresholds.path.nearend.15min.SES	3 (seconds)	0 - 900
STM4-4.pmthresholds.path.nearend.15min.UAS	10 (seconds)	0 - 900
STM4-4.pmthresholds.path.nearend.1day.BBE	250 (count)	0 - 207273600
STM4-4.pmthresholds.path.nearend.1day.EB	125 (count)	0 - 691200000
STM4-4.pmthresholds.path.nearend.1day.ES	100 (seconds)	0 - 86400
STM4-4.pmthresholds.path.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
STM4-4.pmthresholds.path.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
STM4-4.pmthresholds.path.nearend.1day.PJCDIFF	5760 (count)	0 - 1382400000

Table C-10 STM4-4 Card Default Settings (continued)

Default Name	Default Value	Default Domain
STM4-4.pmthresholds.path.nearend.1day.PJCS-PDET	9600 (seconds)	0 - 86400
STM4-4.pmthresholds.path.nearend.1day.PJCS-PGEN	9600 (seconds)	0 - 86400
STM4-4.pmthresholds.path.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
STM4-4.pmthresholds.path.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
STM4-4.pmthresholds.path.nearend.1day.SES	7 (seconds)	0 - 86400
STM4-4.pmthresholds.path.nearend.1day.UAS	10 (seconds)	0 - 86400
STM4-4.pmthresholds.rs.nearend.15min.BBE	10000 (count)	0 - 553500
STM4-4.pmthresholds.rs.nearend.15min.EB	10000 (count)	0 - 553500
STM4-4.pmthresholds.rs.nearend.15min.ES	500 (seconds)	0 - 900
STM4-4.pmthresholds.rs.nearend.15min.SEFS	500 (seconds)	0 - 900
STM4-4.pmthresholds.rs.nearend.15min.SES	500 (seconds)	0 - 900
STM4-4.pmthresholds.rs.nearend.15min.UAS	3 (seconds)	0 - 900
STM4-4.pmthresholds.rs.nearend.1day.BBE	100000 (count)	0 - 53136000
STM4-4.pmthresholds.rs.nearend.1day.EB	100000 (count)	0 - 53136000
STM4-4.pmthresholds.rs.nearend.1day.ES	5000 (seconds)	0 - 86400
STM4-4.pmthresholds.rs.nearend.1day.SEFS	5000 (seconds)	0 - 86400
STM4-4.pmthresholds.rs.nearend.1day.SES	5000 (seconds)	0 - 86400
STM4-4.pmthresholds.rs.nearend.1day.UAS	10 (seconds)	0 - 86400

C.2.3.11 STM-16 Card Default Settings

Table C-11 lists the STM-16 card default settings.

Table C-11 STM-16 Card Default Settings

Default Name	Default Value	Default Domain
STM16.config.line.AdminSSMIn	STU	G811, STU, G812T, G812L, SETS, DUS
STM16.config.line.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
STM16.config.line.AlsMode	Disabled	Disabled, Auto Restart, Manual Restart, Manual Restart for Test
STM16.config.line.AlsRecoveryPulseDuration	2.0 (seconds)	2.0, 2.1, 2.2 .. 100.0 when AlsMode Disabled, Auto Restart, Manual Restart; 80.0, 80.1, 80.2 .. 100.0 when AlsMode Manual Restart for Test
STM16.config.line.AlsRecoveryPulseInterval	100 (seconds)	60 - 300
STM16.config.line.PJVC4Mon#	0 (VC4 #)	0 - 16
STM16.config.line.SDBER	1.00E-07	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
STM16.config.line.Send<FF>DoNotUse	FALSE	FALSE when SendDoNotUse TRUE; FALSE, TRUE when SendDoNotUse FALSE

Table C-11 STM-16 Card Default Settings (continued)

Default Name	Default Value	Default Domain
STM16.config.line.SendDoNotUse	FALSE	FALSE, TRUE
STM16.config.line.SFBER	1.00E-04	1E-3, 1E-4, 1E-5
STM16.config.line.State	unlocked, automaticInService	unlocked, locked, disabled, locked, maintenance, unlocked, automaticInService
STM16.config.line.SyncMsgIn	TRUE	FALSE, TRUE
STM16.config.vc4.IPPMEnabled	FALSE	TRUE, FALSE
STM16.pmthresholds.ms.farend.15min.BBE	21260 (count)	0 - 2212200
STM16.pmthresholds.ms.farend.15min.EB	21260 (count)	0 - 2212200
STM16.pmthresholds.ms.farend.15min.ES	87 (seconds)	0 - 900
STM16.pmthresholds.ms.farend.15min.SES	1 (seconds)	0 - 900
STM16.pmthresholds.ms.farend.15min.UAS	3 (seconds)	0 - 900
STM16.pmthresholds.ms.farend.1day.BBE	212600 (count)	0 - 212371200
STM16.pmthresholds.ms.farend.1day.EB	212600 (count)	0 - 212371200
STM16.pmthresholds.ms.farend.1day.ES	864 (seconds)	0 - 86400
STM16.pmthresholds.ms.farend.1day.SES	4 (seconds)	0 - 86400
STM16.pmthresholds.ms.farend.1day.UAS	10 (seconds)	0 - 86400
STM16.pmthresholds.ms.nearend.15min.BBE	21260 (count)	0 - 2212200
STM16.pmthresholds.ms.nearend.15min.EB	21260 (count)	0 - 2212200
STM16.pmthresholds.ms.nearend.15min.ES	87 (seconds)	0 - 900
STM16.pmthresholds.ms.nearend.15min.PSC	1 (count)	0 - 600
STM16.pmthresholds.ms.nearend.15min.PSC-R	1 (count)	0 - 600
STM16.pmthresholds.ms.nearend.15min.PSC-S	1 (count)	0 - 600
STM16.pmthresholds.ms.nearend.15min.PSC-W	1 (count)	0 - 600
STM16.pmthresholds.ms.nearend.15min.PSD	300 (seconds)	0 - 900
STM16.pmthresholds.ms.nearend.15min.PSD-R	300 (seconds)	0 - 900
STM16.pmthresholds.ms.nearend.15min.PSD-S	300 (seconds)	0 - 900
STM16.pmthresholds.ms.nearend.15min.PSD-W	300 (seconds)	0 - 900
STM16.pmthresholds.ms.nearend.15min.SES	1 (seconds)	0 - 900
STM16.pmthresholds.ms.nearend.15min.UAS	3 (seconds)	0 - 900
STM16.pmthresholds.ms.nearend.1day.BBE	212600 (count)	0 - 212371200
STM16.pmthresholds.ms.nearend.1day.EB	212600 (count)	0 - 212371200
STM16.pmthresholds.ms.nearend.1day.ES	864 (seconds)	0 - 86400
STM16.pmthresholds.ms.nearend.1day.PSC	5 (count)	0 - 57600
STM16.pmthresholds.ms.nearend.1day.PSC-R	5 (count)	0 - 57600
STM16.pmthresholds.ms.nearend.1day.PSC-S	5 (count)	0 - 57600
STM16.pmthresholds.ms.nearend.1day.PSC-W	5 (count)	0 - 57600

Table C-11 STM-16 Card Default Settings (continued)

Default Name	Default Value	Default Domain
STM16.pmthresholds.ms.nearend.1day.PSD	600 (seconds)	0 - 86400
STM16.pmthresholds.ms.nearend.1day.PSD-R	600 (seconds)	0 - 86400
STM16.pmthresholds.ms.nearend.1day.PSD-S	600 (seconds)	0 - 86400
STM16.pmthresholds.ms.nearend.1day.PSD-W	600 (seconds)	0 - 86400
STM16.pmthresholds.ms.nearend.1day.SES	4 (seconds)	0 - 86400
STM16.pmthresholds.ms.nearend.1day.UAS	10 (seconds)	0 - 86400
STM16.pmthresholds.path.nearend.15min.BBE	25 (count)	0 - 2159100
STM16.pmthresholds.path.nearend.15min.EB	15 (count)	0 - 7200000
STM16.pmthresholds.path.nearend.15min.ES	12 (seconds)	0 - 900
STM16.pmthresholds.path.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
STM16.pmthresholds.path.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
STM16.pmthresholds.path.nearend.15min.PJCDIFF	60 (count)	0 - 14400000
STM16.pmthresholds.path.nearend.15min.PJCS-PDET	100 (seconds)	0 - 900
STM16.pmthresholds.path.nearend.15min.PJCS-PGEN	100 (seconds)	0 - 900
STM16.pmthresholds.path.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
STM16.pmthresholds.path.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
STM16.pmthresholds.path.nearend.15min.SES	3 (seconds)	0 - 900
STM16.pmthresholds.path.nearend.15min.UAS	10 (seconds)	0 - 900
STM16.pmthresholds.path.nearend.1day.BBE	250 (count)	0 - 207273600
STM16.pmthresholds.path.nearend.1day.EB	125 (count)	0 - 691200000
STM16.pmthresholds.path.nearend.1day.ES	100 (seconds)	0 - 86400
STM16.pmthresholds.path.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
STM16.pmthresholds.path.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
STM16.pmthresholds.path.nearend.1day.PJCDIFF	5760 (count)	0 - 1382400000
STM16.pmthresholds.path.nearend.1day.PJCS-PDET	9600 (seconds)	0 - 86400
STM16.pmthresholds.path.nearend.1day.PJCS-PGEN	9600 (seconds)	0 - 86400
STM16.pmthresholds.path.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
STM16.pmthresholds.path.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
STM16.pmthresholds.path.nearend.1day.SES	7 (seconds)	0 - 86400
STM16.pmthresholds.path.nearend.1day.UAS	10 (seconds)	0 - 86400
STM16.pmthresholds.rs.nearend.15min.BBE	10000 (count)	0 - 2151900
STM16.pmthresholds.rs.nearend.15min.EB	10000 (count)	0 - 2151900
STM16.pmthresholds.rs.nearend.15min.ES	500 (seconds)	0 - 900
STM16.pmthresholds.rs.nearend.15min.SEFS	500 (seconds)	0 - 900
STM16.pmthresholds.rs.nearend.15min.SES	500 (seconds)	0 - 900
STM16.pmthresholds.rs.nearend.15min.UAS	3 (seconds)	0 - 900

Table C-11 STM-16 Card Default Settings (continued)

Default Name	Default Value	Default Domain
STM16.pmthresholds.rs.nearend.1day.BBE	100000 (count)	0 - 206582400
STM16.pmthresholds.rs.nearend.1day.EB	100000 (count)	0 - 206582400
STM16.pmthresholds.rs.nearend.1day.ES	5000 (seconds)	0 - 86400
STM16.pmthresholds.rs.nearend.1day.SEFS	5000 (seconds)	0 - 86400
STM16.pmthresholds.rs.nearend.1day.SES	5000 (seconds)	0 - 86400
STM16.pmthresholds.rs.nearend.1day.UAS	10 (seconds)	0 - 86400

C.2.3.12 STM-64 Card Default Settings

Table C-12 lists the STM-64 card default settings.

Table C-12 STM-64 Card Default Settings

Default Name	Default Value	Default Domain
STM64.config.line.AdminSSMIn	STU	G811, STU, G812T, G812L, SETS, DUS
STM64.config.line.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
STM64.config.line.AlsMode	Disabled	Disabled, Auto Restart, Manual Restart, Manual Restart for Test
STM64.config.line.AlsRecoveryPulseDuration	2.0 (seconds)	2.0, 2.1, 2.2 .. 100.0 when AlsMode Disabled, Auto Restart, Manual Restart; 80.0, 80.1, 80.2 .. 100.0 when AlsMode Manual Restart for Test
STM64.config.line.AlsRecoveryPulseInterval	100 (seconds)	60 - 300
STM64.config.line.PJVC4Mon#	0 (VC4 #)	0 - 64
STM64.config.line.SDBER	1.00E-07	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
STM64.config.line.Send<FF>DoNotUse	FALSE	FALSE when SendDoNotUse TRUE; FALSE, TRUE when SendDoNotUse FALSE
STM64.config.line.SendDoNotUse	FALSE	FALSE, TRUE
STM64.config.line.SFBER	1.00E-04	1E-3, 1E-4, 1E-5
STM64.config.line.State	unlocked, automaticInServic e	unlocked, locked, disabled, locked, maintenance, unlocked, automaticInService
STM64.config.line.SyncMsgIn	TRUE	FALSE, TRUE
STM64.config.vc4.IPPMEnabled	FALSE	TRUE, FALSE
STM64.physicalthresholds.alarm.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1.0, LBC-LOW + 2.0 .. 255.0
STM64.physicalthresholds.alarm.LBC-LOW	20 (%)	0.0, 1.0, 2.0 .. LBC-HIGH
STM64.physicalthresholds.alarm.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1.0, OPR-LOW + 2.0 .. 255.0
STM64.physicalthresholds.alarm.OPR-LOW	50 (%)	-1.0, 0.0, 1.0 .. OPR-HIGH

Table C-12 STM-64 Card Default Settings (continued)

Default Name	Default Value	Default Domain
STM64.physicalthresholds.alarm.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1.0, OPT-LOW + 2.0 .. 255.0
STM64.physicalthresholds.alarm.OPT-LOW	80 (%)	0.0, 1.0, 2.0 .. OPT-HIGH
STM64.physicalthresholds.warning.15min.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1.0, LBC-LOW + 2.0 .. 255.0
STM64.physicalthresholds.warning.15min.LBC-LOW	20 (%)	0.0, 1.0, 2.0 .. LBC-HIGH
STM64.physicalthresholds.warning.15min.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1.0, OPR-LOW + 2.0 .. 255.0
STM64.physicalthresholds.warning.15min.OPR-LOW	50 (%)	-1.0, 0.0, 1.0 .. OPR-HIGH
STM64.physicalthresholds.warning.15min.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1.0, OPT-LOW + 2.0 .. 255.0
STM64.physicalthresholds.warning.15min.OPT-LOW	80 (%)	0.0, 1.0, 2.0 .. OPT-HIGH
STM64.physicalthresholds.warning.1day.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1.0, LBC-LOW + 2.0 .. 255.0
STM64.physicalthresholds.warning.1day.LBC-LOW	20 (%)	0.0, 1.0, 2.0 .. LBC-HIGH
STM64.physicalthresholds.warning.1day.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1.0, OPR-LOW + 2.0 .. 255.0
STM64.physicalthresholds.warning.1day.OPR-LOW	50 (%)	-1.0, 0.0, 1.0 .. OPR-HIGH
STM64.physicalthresholds.warning.1day.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1.0, OPT-LOW + 2.0 .. 255.0
STM64.physicalthresholds.warning.1day.OPT-LOW	80 (%)	0.0, 1.0, 2.0 .. OPT-HIGH
STM64.pmthresholds.ms.farend.15min.BBE	85040 (count)	0 - 8850600
STM64.pmthresholds.ms.farend.15min.EB	85040 (count)	0 - 8850600
STM64.pmthresholds.ms.farend.15min.ES	87 (seconds)	0 - 900
STM64.pmthresholds.ms.farend.15min.SES	1 (seconds)	0 - 900
STM64.pmthresholds.ms.farend.15min.UAS	3 (seconds)	0 - 900
STM64.pmthresholds.ms.farend.1day.BBE	850400 (count)	0 - 849657600
STM64.pmthresholds.ms.farend.1day.EB	850400 (count)	0 - 849657600
STM64.pmthresholds.ms.farend.1day.ES	864 (seconds)	0 - 86400
STM64.pmthresholds.ms.farend.1day.SES	4 (seconds)	0 - 86400
STM64.pmthresholds.ms.farend.1day.UAS	10 (seconds)	0 - 86400
STM64.pmthresholds.ms.nearend.15min.BBE	85040 (count)	0 - 8850600
STM64.pmthresholds.ms.nearend.15min.EB	85040 (count)	0 - 8850600
STM64.pmthresholds.ms.nearend.15min.ES	87 (seconds)	0 - 900
STM64.pmthresholds.ms.nearend.15min.PSC	1 (count)	0 - 600
STM64.pmthresholds.ms.nearend.15min.PSC-R	1 (count)	0 - 600
STM64.pmthresholds.ms.nearend.15min.PSC-S	1 (count)	0 - 600
STM64.pmthresholds.ms.nearend.15min.PSC-W	1 (count)	0 - 600

Table C-12 STM-64 Card Default Settings (continued)

Default Name	Default Value	Default Domain
STM64.pmthresholds.ms.nearend.15min.PSD	300 (seconds)	0 - 900
STM64.pmthresholds.ms.nearend.15min.PSD-R	300 (seconds)	0 - 900
STM64.pmthresholds.ms.nearend.15min.PSD-S	300 (seconds)	0 - 900
STM64.pmthresholds.ms.nearend.15min.PSD-W	300 (seconds)	0 - 900
STM64.pmthresholds.ms.nearend.15min.SES	1 (seconds)	0 - 900
STM64.pmthresholds.ms.nearend.15min.UAS	3 (seconds)	0 - 900
STM64.pmthresholds.ms.nearend.1day.BBE	850400 (count)	0 - 849657600
STM64.pmthresholds.ms.nearend.1day.EB	850400 (count)	0 - 849657600
STM64.pmthresholds.ms.nearend.1day.ES	864 (seconds)	0 - 86400
STM64.pmthresholds.ms.nearend.1day.PSC	5 (count)	0 - 57600
STM64.pmthresholds.ms.nearend.1day.PSC-R	5 (count)	0 - 57600
STM64.pmthresholds.ms.nearend.1day.PSC-S	5 (count)	0 - 57600
STM64.pmthresholds.ms.nearend.1day.PSC-W	5 (count)	0 - 57600
STM64.pmthresholds.ms.nearend.1day.PSD	600 (seconds)	0 - 86400
STM64.pmthresholds.ms.nearend.1day.PSD-R	600 (seconds)	0 - 86400
STM64.pmthresholds.ms.nearend.1day.PSD-S	600 (seconds)	0 - 86400
STM64.pmthresholds.ms.nearend.1day.PSD-W	600 (seconds)	0 - 86400
STM64.pmthresholds.ms.nearend.1day.SES	4 (seconds)	0 - 86400
STM64.pmthresholds.ms.nearend.1day.UAS	10 (seconds)	0 - 86400
STM64.pmthresholds.path.nearend.15min.BBE	25 (count)	0 - 2159100
STM64.pmthresholds.path.nearend.15min.EB	15 (count)	0 - 7200000
STM64.pmthresholds.path.nearend.15min.ES	12 (seconds)	0 - 900
STM64.pmthresholds.path.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
STM64.pmthresholds.path.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
STM64.pmthresholds.path.nearend.15min.PJCDIFF	60 (count)	0 - 14400000
STM64.pmthresholds.path.nearend.15min.PJCS-PDET	100 (seconds)	0 - 900
STM64.pmthresholds.path.nearend.15min.PJCS-PGEN	100 (seconds)	0 - 900
STM64.pmthresholds.path.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
STM64.pmthresholds.path.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
STM64.pmthresholds.path.nearend.15min.SES	3 (seconds)	0 - 900
STM64.pmthresholds.path.nearend.15min.UAS	10 (seconds)	0 - 900
STM64.pmthresholds.path.nearend.1day.BBE	250 (count)	0 - 207273600
STM64.pmthresholds.path.nearend.1day.EB	125 (count)	0 - 691200000
STM64.pmthresholds.path.nearend.1day.ES	100 (seconds)	0 - 86400
STM64.pmthresholds.path.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
STM64.pmthresholds.path.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000

Table C-12 STM-64 Card Default Settings (continued)

Default Name	Default Value	Default Domain
STM64.pmthresholds.path.nearend.1day.PJCDIFF	5760 (count)	0 - 1382400000
STM64.pmthresholds.path.nearend.1day.PJCS-PDET	9600 (seconds)	0 - 86400
STM64.pmthresholds.path.nearend.1day.PJCS-PGEN	9600 (seconds)	0 - 86400
STM64.pmthresholds.path.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
STM64.pmthresholds.path.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
STM64.pmthresholds.path.nearend.1day.SES	7 (seconds)	0 - 86400
STM64.pmthresholds.path.nearend.1day.UAS	10 (seconds)	0 - 86400
STM64.pmthresholds.rs.nearend.15min.BBE	10000 (count)	0 - 7967700
STM64.pmthresholds.rs.nearend.15min.EB	10000 (count)	0 - 7967700
STM64.pmthresholds.rs.nearend.15min.ES	500 (seconds)	0 - 900
STM64.pmthresholds.rs.nearend.15min.SEFS	500 (seconds)	0 - 900
STM64.pmthresholds.rs.nearend.15min.SES	500 (seconds)	0 - 900
STM64.pmthresholds.rs.nearend.15min.UAS	3 (seconds)	0 - 900
STM64.pmthresholds.rs.nearend.1day.BBE	100000 (count)	0 - 764899200
STM64.pmthresholds.rs.nearend.1day.EB	100000 (count)	0 - 764899200
STM64.pmthresholds.rs.nearend.1day.ES	5000 (seconds)	0 - 86400
STM64.pmthresholds.rs.nearend.1day.SEFS	5000 (seconds)	0 - 86400
STM64.pmthresholds.rs.nearend.1day.SES	5000 (seconds)	0 - 86400
STM64.pmthresholds.rs.nearend.1day.UAS	10 (seconds)	0 - 86400

C.2.3.13 STM64-XFP Default Settings

Table C-13 lists the STM64-XFP default settings.

Table C-13 STM64-XFP Default Settings

Default Name	Default Value	Default Domain
STM64-XFP.config.line.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
STM64-XFP.config.line.AlsMode	Disabled	Disabled, Auto Restart, Manual Restart, Manual Restart for Test
STM64-XFP.config.line.AlsRecoveryPulseDuration	2.0 (seconds)	2.0, 2.1, 2.2 .. 100.0 when AlsMode Disabled, Auto Restart, Manual Restart; 80.0, 80.1, 80.2 .. 100.0 when AlsMode Manual Restart for Test
STM64-XFP.config.line.AlsRecoveryPulseInterval	100 (seconds)	60 - 300
STM64-XFP.config.line.PJVC4Mon#	0 (VC4 #)	0 - 64
STM64-XFP.config.line.SDBER	1.00E-07	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
STM64-XFP.config.line.Send<FF>DoNotUse	FALSE	FALSE when SendDoNotUse TRUE; FALSE, TRUE when SendDoNotUse FALSE

Table C-13 STM64-XFP Default Settings (continued)

Default Name	Default Value	Default Domain
STM64-XFP.config.line.SendDoNotUse	FALSE	FALSE, TRUE
STM64-XFP.config.line.SFBER	1.00E-04	1E-3, 1E-4, 1E-5
STM64-XFP.config.line.State	unlocked, automaticInService	unlocked, locked, disabled, locked, maintenance, unlocked, automaticInService
STM64-XFP.config.line.SyncMsgIn	TRUE	FALSE, TRUE
STM64-XFP.config.vc4.IPPMEnabled	FALSE	TRUE, FALSE
STM64-XFP.physicalthresholds.alarm.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1.0, LBC-LOW + 2.0 .. 255.0
STM64-XFP.physicalthresholds.alarm.LBC-LOW	20 (%)	0.0, 1.0, 2.0 .. LBC-HIGH
STM64-XFP.physicalthresholds.alarm.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1.0, OPR-LOW + 2.0 .. 255.0
STM64-XFP.physicalthresholds.alarm.OPR-LOW	50 (%)	-1.0, 0.0, 1.0 .. OPR-HIGH
STM64-XFP.physicalthresholds.alarm.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1.0, OPT-LOW + 2.0 .. 255.0
STM64-XFP.physicalthresholds.alarm.OPT-LOW	80 (%)	0.0, 1.0, 2.0 .. OPT-HIGH
STM64-XFP.physicalthresholds.warning.15min.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1.0, LBC-LOW + 2.0 .. 255.0
STM64-XFP.physicalthresholds.warning.15min.LBC-LOW	20 (%)	0.0, 1.0, 2.0 .. LBC-HIGH
STM64-XFP.physicalthresholds.warning.15min.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1.0, OPR-LOW + 2.0 .. 255.0
STM64-XFP.physicalthresholds.warning.15min.OPR-LOW	50 (%)	-1.0, 0.0, 1.0 .. OPR-HIGH
STM64-XFP.physicalthresholds.warning.15min.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1.0, OPT-LOW + 2.0 .. 255.0
STM64-XFP.physicalthresholds.warning.15min.OPT-LOW	80 (%)	0.0, 1.0, 2.0 .. OPT-HIGH
STM64-XFP.physicalthresholds.warning.1day.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1.0, LBC-LOW + 2.0 .. 255.0
STM64-XFP.physicalthresholds.warning.1day.LBC-LOW	20 (%)	0.0, 1.0, 2.0 .. LBC-HIGH
STM64-XFP.physicalthresholds.warning.1day.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1.0, OPR-LOW + 2.0 .. 255.0
STM64-XFP.physicalthresholds.warning.1day.OPR-LOW	50 (%)	-1.0, 0.0, 1.0 .. OPR-HIGH
STM64-XFP.physicalthresholds.warning.1day.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1.0, OPT-LOW + 2.0 .. 255.0
STM64-XFP.physicalthresholds.warning.1day.OPT-LOW	80 (%)	0.0, 1.0, 2.0 .. OPT-HIGH
STM64-XFP.pmthresholds.ms.farend.15min.BBE	85040 (count)	0 - 8850600
STM64-XFP.pmthresholds.ms.farend.15min.EB	85040 (count)	0 - 8850600
STM64-XFP.pmthresholds.ms.farend.15min.ES	87 (seconds)	0 - 900
STM64-XFP.pmthresholds.ms.farend.15min.SES	1 (seconds)	0 - 900
STM64-XFP.pmthresholds.ms.farend.15min.UAS	3 (seconds)	0 - 900

Table C-13 STM64-XFP Default Settings (continued)

Default Name	Default Value	Default Domain
STM64-XFP.pmthresholds.ms.farend.1day.BBE	850400 (count)	0 - 849657600
STM64-XFP.pmthresholds.ms.farend.1day.EB	850400 (count)	0 - 849657600
STM64-XFP.pmthresholds.ms.farend.1day.ES	864 (seconds)	0 - 86400
STM64-XFP.pmthresholds.ms.farend.1day.SES	4 (seconds)	0 - 86400
STM64-XFP.pmthresholds.ms.farend.1day.UAS	10 (seconds)	0 - 86400
STM64-XFP.pmthresholds.ms.nearend.15min.BBE	85040 (count)	0 - 8850600
STM64-XFP.pmthresholds.ms.nearend.15min.EB	85040 (count)	0 - 8850600
STM64-XFP.pmthresholds.ms.nearend.15min.ES	87 (seconds)	0 - 900
STM64-XFP.pmthresholds.ms.nearend.15min.PSC	1 (count)	0 - 600
STM64-XFP.pmthresholds.ms.nearend.15min.PSC-R	1 (count)	0 - 600
STM64-XFP.pmthresholds.ms.nearend.15min.PSC-S	1 (count)	0 - 600
STM64-XFP.pmthresholds.ms.nearend.15min.PSC-W	1 (count)	0 - 600
STM64-XFP.pmthresholds.ms.nearend.15min.PSD	300 (seconds)	0 - 900
STM64-XFP.pmthresholds.ms.nearend.15min.PSD-R	300 (seconds)	0 - 900
STM64-XFP.pmthresholds.ms.nearend.15min.PSD-S	300 (seconds)	0 - 900
STM64-XFP.pmthresholds.ms.nearend.15min.PSD-W	300 (seconds)	0 - 900
STM64-XFP.pmthresholds.ms.nearend.15min.SES	1 (seconds)	0 - 900
STM64-XFP.pmthresholds.ms.nearend.15min.UAS	3 (seconds)	0 - 900
STM64-XFP.pmthresholds.ms.nearend.1day.BBE	850400 (count)	0 - 849657600
STM64-XFP.pmthresholds.ms.nearend.1day.EB	850400 (count)	0 - 849657600
STM64-XFP.pmthresholds.ms.nearend.1day.ES	864 (seconds)	0 - 86400
STM64-XFP.pmthresholds.ms.nearend.1day.PSC	5 (count)	0 - 57600
STM64-XFP.pmthresholds.ms.nearend.1day.PSC-R	5 (count)	0 - 57600
STM64-XFP.pmthresholds.ms.nearend.1day.PSC-S	5 (count)	0 - 57600
STM64-XFP.pmthresholds.ms.nearend.1day.PSC-W	5 (count)	0 - 57600
STM64-XFP.pmthresholds.ms.nearend.1day.PSD	600 (seconds)	0 - 86400
STM64-XFP.pmthresholds.ms.nearend.1day.PSD-R	600 (seconds)	0 - 86400
STM64-XFP.pmthresholds.ms.nearend.1day.PSD-S	600 (seconds)	0 - 86400
STM64-XFP.pmthresholds.ms.nearend.1day.PSD-W	600 (seconds)	0 - 86400
STM64-XFP.pmthresholds.ms.nearend.1day.SES	4 (seconds)	0 - 86400
STM64-XFP.pmthresholds.ms.nearend.1day.UAS	10 (seconds)	0 - 86400
STM64-XFP.pmthresholds.path.farend.15min.BBE	25 (count)	0 - 2159100
STM64-XFP.pmthresholds.path.farend.15min.EB	15 (count)	0 - 7200000
STM64-XFP.pmthresholds.path.farend.15min.ES	12 (seconds)	0 - 900
STM64-XFP.pmthresholds.path.farend.15min.SES	3 (seconds)	0 - 900
STM64-XFP.pmthresholds.path.farend.15min.UAS	10 (seconds)	0 - 900

Table C-13 STM64-XFP Default Settings (continued)

Default Name	Default Value	Default Domain
STM64-XFP.pmthresholds.path.farend.1day.BBE	250 (count)	0 - 207273600
STM64-XFP.pmthresholds.path.farend.1day.EB	125 (count)	0 - 691200000
STM64-XFP.pmthresholds.path.farend.1day.ES	100 (seconds)	0 - 86400
STM64-XFP.pmthresholds.path.farend.1day.SES	7 (seconds)	0 - 86400
STM64-XFP.pmthresholds.path.farend.1day.UAS	10 (seconds)	0 - 86400
STM64-XFP.pmthresholds.path.nearend.15min.BBE	25 (count)	0 - 2159100
STM64-XFP.pmthresholds.path.nearend.15min.EB	15 (count)	0 - 7200000
STM64-XFP.pmthresholds.path.nearend.15min.ES	12 (seconds)	0 - 900
STM64-XFP.pmthresholds.path.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
STM64-XFP.pmthresholds.path.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
STM64-XFP.pmthresholds.path.nearend.15min.PJCDIFF	60 (count)	0 - 1200
STM64-XFP.pmthresholds.path.nearend.15min.PJCS-PDET	100 (seconds)	0 - 7200000
STM64-XFP.pmthresholds.path.nearend.15min.PJCS-PGEN	100 (seconds)	0 - 7200000
STM64-XFP.pmthresholds.path.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
STM64-XFP.pmthresholds.path.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
STM64-XFP.pmthresholds.path.nearend.15min.SES	3 (seconds)	0 - 900
STM64-XFP.pmthresholds.path.nearend.15min.UAS	10 (seconds)	0 - 900
STM64-XFP.pmthresholds.path.nearend.1day.BBE	250 (count)	0 - 207273600
STM64-XFP.pmthresholds.path.nearend.1day.EB	125 (count)	0 - 691200000
STM64-XFP.pmthresholds.path.nearend.1day.ES	100 (seconds)	0 - 86400
STM64-XFP.pmthresholds.path.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
STM64-XFP.pmthresholds.path.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
STM64-XFP.pmthresholds.path.nearend.1day.PJCDIFF	5760 (count)	0 - 115200
STM64-XFP.pmthresholds.path.nearend.1day.PJCS-PDET	9600 (seconds)	0 - 691200000
STM64-XFP.pmthresholds.path.nearend.1day.PJCS-PGEN	9600 (seconds)	0 - 691200000
STM64-XFP.pmthresholds.path.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
STM64-XFP.pmthresholds.path.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
STM64-XFP.pmthresholds.path.nearend.1day.SES	7 (seconds)	0 - 86400
STM64-XFP.pmthresholds.path.nearend.1day.UAS	10 (seconds)	0 - 86400
STM64-XFP.pmthresholds.rs.nearend.15min.BBE	10000 (count)	0 - 7967700
STM64-XFP.pmthresholds.rs.nearend.15min.EB	10000 (count)	0 - 7967700
STM64-XFP.pmthresholds.rs.nearend.15min.ES	500 (seconds)	0 - 900
STM64-XFP.pmthresholds.rs.nearend.15min.SEFS	500 (seconds)	0 - 900
STM64-XFP.pmthresholds.rs.nearend.15min.SES	500 (seconds)	0 - 900
STM64-XFP.pmthresholds.rs.nearend.15min.UAS	3 (seconds)	0 - 900
STM64-XFP.pmthresholds.rs.nearend.1day.BBE	100000 (count)	0 - 764899200

Table C-13 STM64-XFP Default Settings (continued)

Default Name	Default Value	Default Domain
STM64-XFP.pmthresholds.rs.nearend.1day.EB	100000 (count)	0 - 764899200
STM64-XFP.pmthresholds.rs.nearend.1day.ES	5000 (seconds)	0 - 86400
STM64-XFP.pmthresholds.rs.nearend.1day.SEFS	5000 (seconds)	0 - 86400
STM64-XFP.pmthresholds.rs.nearend.1day.SES	5000 (seconds)	0 - 86400
STM64-XFP.pmthresholds.rs.nearend.1day.UAS	10 (seconds)	0 - 86400

C.2.3.14 MRC-12 Card Default Settings

Table C-14 lists the MRC-12 card default settings.

Table C-14 MRC-12 Card Default Settings

Default Name	Default Value	Default Domain
MRC-12.config.stm1.line.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
MRC-12.config.stm1.line.AlsMode	Disabled	Disabled, Auto Restart, Manual Restart, Manual Restart for Test
MRC-12.config.stm1.line.AlsRecoveryPulseDuration	2.0 (seconds)	2.0, 2.1, 2.2 .. 100.0 when AlsMode Disabled, Auto Restart, Manual Restart; 80.0, 80.1, 80.2 .. 100.0 when AlsMode Manual Restart for Test
MRC-12.config.stm1.line.AlsRecoveryPulseInterval	100 (seconds)	60 - 300
MRC-12.config.stm1.line.PJVC4Mon#	0 (VC4 #)	0 - 1
MRC-12.config.stm1.line.SDBER	1.00E-07	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
MRC-12.config.stm1.line.Send<FF>DoNotUse	FALSE	FALSE when SendDoNotUse TRUE; FALSE, TRUE when SendDoNotUse FALSE
MRC-12.config.stm1.line.SendDoNotUse	FALSE	FALSE, TRUE
MRC-12.config.stm1.line.SFBER	1.00E-04	1E-3, 1E-4, 1E-5
MRC-12.config.stm1.line.State	unlocked, automaticInService	unlocked, locked, disabled, locked, maintenance, unlocked, automaticInService
MRC-12.config.stm1.line.SyncMsgIn	TRUE	FALSE, TRUE
MRC-12.config.stm1.vc4.IPPMEnabled	FALSE	TRUE, FALSE
MRC-12.config.stm16.line.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
MRC-12.config.stm16.line.AlsMode	Disabled	Disabled, Auto Restart, Manual Restart, Manual Restart for Test
MRC-12.config.stm16.line.AlsRecoveryPulseDuration	2.0 (seconds)	2.0, 2.1, 2.2 .. 100.0 when AlsMode Disabled, Auto Restart, Manual Restart; 80.0, 80.1, 80.2 .. 100.0 when AlsMode Manual Restart for Test

Table C-14 MRC-12 Card Default Settings (continued)

Default Name	Default Value	Default Domain
MRC-12.config.stm16.line.AlsRecoveryPulseInterval	100 (seconds)	60 - 300
MRC-12.config.stm16.line.PJVC4Mon#	0 (VC4 #)	0 - 16
MRC-12.config.stm16.line.SDBER	1.00E-07	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
MRC-12.config.stm16.line.Send<FF>DoNotUse	FALSE	FALSE when SendDoNotUse TRUE; FALSE, TRUE when SendDoNotUse FALSE
MRC-12.config.stm16.line.SendDoNotUse	FALSE	FALSE, TRUE
MRC-12.config.stm16.line.SFBER	1.00E-04	1E-3, 1E-4, 1E-5
MRC-12.config.stm16.line.State	unlocked, automaticInService	unlocked, locked, disabled, locked, maintenance, unlocked, automaticInService
MRC-12.config.stm16.line.SyncMsgIn	TRUE	FALSE, TRUE
MRC-12.config.stm16.vc4.IPPMEnabled	FALSE	TRUE, FALSE
MRC-12.config.stm4.line.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
MRC-12.config.stm4.line.AlsMode	Disabled	Disabled, Auto Restart, Manual Restart, Manual Restart for Test
MRC-12.config.stm4.line.AlsRecoveryPulseDuration	2.0 (seconds)	2.0, 2.1, 2.2 .. 100.0 when AlsMode Disabled, Auto Restart, Manual Restart; 80.0, 80.1, 80.2 .. 100.0 when AlsMode Manual Restart for Test
MRC-12.config.stm4.line.AlsRecoveryPulseInterval	100 (seconds)	60 - 300
MRC-12.config.stm4.line.PJVC4Mon#	0 (VC4 #)	0 - 4
MRC-12.config.stm4.line.SDBER	1.00E-07	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
MRC-12.config.stm4.line.Send<FF>DoNotUse	FALSE	FALSE when SendDoNotUse TRUE; FALSE, TRUE when SendDoNotUse FALSE
MRC-12.config.stm4.line.SendDoNotUse	FALSE	FALSE, TRUE
MRC-12.config.stm4.line.SFBER	1.00E-04	1E-3, 1E-4, 1E-5
MRC-12.config.stm4.line.State	unlocked, automaticInService	unlocked, locked, disabled, locked, maintenance, unlocked, automaticInService
MRC-12.config.stm4.line.SyncMsgIn	TRUE	FALSE, TRUE
MRC-12.config.stm4.vc4.IPPMEnabled	FALSE	TRUE, FALSE
MRC-12.physicalthresholds.stm1.alarm.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1.0, LBC-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm1.alarm.LBC-LOW	20 (%)	0.0, 1.0, 2.0 .. LBC-HIGH
MRC-12.physicalthresholds.stm1.alarm.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1.0, OPR-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm1.alarm.OPR-LOW	50 (%)	-1.0, 0.0, 1.0 .. OPR-HIGH

Table C-14 MRC-12 Card Default Settings (continued)

Default Name	Default Value	Default Domain
MRC-12.physicalthresholds.stm1.alarm.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1.0, OPT-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm1.alarm.OPT-LOW	80 (%)	0.0, 1.0, 2.0 .. OPT-HIGH
MRC-12.physicalthresholds.stm1.warning.15min.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1.0, LBC-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm1.warning.15min.LBC-LOW	20 (%)	0.0, 1.0, 2.0 .. LBC-HIGH
MRC-12.physicalthresholds.stm1.warning.15min.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1.0, OPR-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm1.warning.15min.OPR-LOW	50 (%)	-1.0, 0.0, 1.0 .. OPR-HIGH
MRC-12.physicalthresholds.stm1.warning.15min.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1.0, OPT-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm1.warning.15min.OPT-LOW	80 (%)	0.0, 1.0, 2.0 .. OPT-HIGH
MRC-12.physicalthresholds.stm1.warning.1day.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1.0, LBC-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm1.warning.1day.LBC-LOW	20 (%)	0.0, 1.0, 2.0 .. LBC-HIGH
MRC-12.physicalthresholds.stm1.warning.1day.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1.0, OPR-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm1.warning.1day.OPR-LOW	50 (%)	-1.0, 0.0, 1.0 .. OPR-HIGH
MRC-12.physicalthresholds.stm1.warning.1day.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1.0, OPT-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm1.warning.1day.OPT-LOW	80 (%)	0.0, 1.0, 2.0 .. OPT-HIGH
MRC-12.physicalthresholds.stm16.alarm.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1.0, LBC-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm16.alarm.LBC-LOW	20 (%)	0.0, 1.0, 2.0 .. LBC-HIGH
MRC-12.physicalthresholds.stm16.alarm.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1.0, OPR-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm16.alarm.OPR-LOW	50 (%)	-1.0, 0.0, 1.0 .. OPR-HIGH
MRC-12.physicalthresholds.stm16.alarm.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1.0, OPT-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm16.alarm.OPT-LOW	80 (%)	0.0, 1.0, 2.0 .. OPT-HIGH
MRC-12.physicalthresholds.stm16.warning.15min.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1.0, LBC-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm16.warning.15min.LBC-LOW	20 (%)	0.0, 1.0, 2.0 .. LBC-HIGH
MRC-12.physicalthresholds.stm16.warning.15min.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1.0, OPR-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm16.warning.15min.OPR-LOW	50 (%)	-1.0, 0.0, 1.0 .. OPR-HIGH
MRC-12.physicalthresholds.stm16.warning.15min.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1.0, OPT-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm16.warning.15min.OPT-LOW	80 (%)	0.0, 1.0, 2.0 .. OPT-HIGH

Table C-14 MRC-12 Card Default Settings (continued)

Default Name	Default Value	Default Domain
MRC-12.physicalthresholds.stm16.warning.1day.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1.0, LBC-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm16.warning.1day.LBC-LOW	20 (%)	0.0, 1.0, 2.0 .. LBC-HIGH
MRC-12.physicalthresholds.stm16.warning.1day.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1.0, OPR-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm16.warning.1day.OPR-LOW	50 (%)	-1.0, 0.0, 1.0 .. OPR-HIGH
MRC-12.physicalthresholds.stm16.warning.1day.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1.0, OPT-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm16.warning.1day.OPT-LOW	80 (%)	0.0, 1.0, 2.0 .. OPT-HIGH
MRC-12.physicalthresholds.stm4.alarm.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1.0, LBC-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm4.alarm.LBC-LOW	20 (%)	0.0, 1.0, 2.0 .. LBC-HIGH
MRC-12.physicalthresholds.stm4.alarm.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1.0, OPR-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm4.alarm.OPR-LOW	50 (%)	-1.0, 0.0, 1.0 .. OPR-HIGH
MRC-12.physicalthresholds.stm4.alarm.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1.0, OPT-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm4.alarm.OPT-LOW	80 (%)	0.0, 1.0, 2.0 .. OPT-HIGH
MRC-12.physicalthresholds.stm4.warning.15min.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1.0, LBC-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm4.warning.15min.LBC-LOW	20 (%)	0.0, 1.0, 2.0 .. LBC-HIGH
MRC-12.physicalthresholds.stm4.warning.15min.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1.0, OPR-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm4.warning.15min.OPR-LOW	50 (%)	-1.0, 0.0, 1.0 .. OPR-HIGH
MRC-12.physicalthresholds.stm4.warning.15min.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1.0, OPT-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm4.warning.15min.OPT-LOW	80 (%)	0.0, 1.0, 2.0 .. OPT-HIGH
MRC-12.physicalthresholds.stm4.warning.1day.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1.0, LBC-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm4.warning.1day.LBC-LOW	20 (%)	0.0, 1.0, 2.0 .. LBC-HIGH
MRC-12.physicalthresholds.stm4.warning.1day.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1.0, OPR-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm4.warning.1day.OPR-LOW	50 (%)	-1.0, 0.0, 1.0 .. OPR-HIGH
MRC-12.physicalthresholds.stm4.warning.1day.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1.0, OPT-LOW + 2.0 .. 255.0
MRC-12.physicalthresholds.stm4.warning.1day.OPT-LOW	80 (%)	0.0, 1.0, 2.0 .. OPT-HIGH
MRC-12.pmthresholds.stm1.ms.farend.15min.BBE	1312 (count)	0 - 137700
MRC-12.pmthresholds.stm1.ms.farend.15min.EB	1312 (count)	0 - 137700
MRC-12.pmthresholds.stm1.ms.farend.15min.ES	87 (seconds)	0 - 900

Table C-14 MRC-12 Card Default Settings (continued)

Default Name	Default Value	Default Domain
MRC-12.pmthresholds.stm1.ms.farend.15min.SES	1 (seconds)	0 - 900
MRC-12.pmthresholds.stm1.ms.farend.15min.UAS	3 (seconds)	0 - 900
MRC-12.pmthresholds.stm1.ms.farend.1day.BBE	13120 (count)	0 - 13219200
MRC-12.pmthresholds.stm1.ms.farend.1day.EB	13120 (count)	0 - 13219200
MRC-12.pmthresholds.stm1.ms.farend.1day.ES	864 (seconds)	0 - 86400
MRC-12.pmthresholds.stm1.ms.farend.1day.SES	4 (seconds)	0 - 86400
MRC-12.pmthresholds.stm1.ms.farend.1day.UAS	10 (seconds)	0 - 86400
MRC-12.pmthresholds.stm1.ms.nearend.15min.BBE	1312 (count)	0 - 137700
MRC-12.pmthresholds.stm1.ms.nearend.15min.EB	1312 (count)	0 - 137700
MRC-12.pmthresholds.stm1.ms.nearend.15min.ES	87 (seconds)	0 - 900
MRC-12.pmthresholds.stm1.ms.nearend.15min.PSC	1 (count)	0 - 600
MRC-12.pmthresholds.stm1.ms.nearend.15min.PSD	300 (seconds)	0 - 900
MRC-12.pmthresholds.stm1.ms.nearend.15min.SES	1 (seconds)	0 - 900
MRC-12.pmthresholds.stm1.ms.nearend.15min.UAS	3 (seconds)	0 - 900
MRC-12.pmthresholds.stm1.ms.nearend.1day.BBE	13120 (count)	0 - 13219200
MRC-12.pmthresholds.stm1.ms.nearend.1day.EB	13120 (count)	0 - 13219200
MRC-12.pmthresholds.stm1.ms.nearend.1day.ES	864 (seconds)	0 - 86400
MRC-12.pmthresholds.stm1.ms.nearend.1day.PSC	5 (count)	0 - 57600
MRC-12.pmthresholds.stm1.ms.nearend.1day.PSD	600 (seconds)	0 - 86400
MRC-12.pmthresholds.stm1.ms.nearend.1day.SES	4 (seconds)	0 - 86400
MRC-12.pmthresholds.stm1.ms.nearend.1day.UAS	10 (seconds)	0 - 86400
MRC-12.pmthresholds.stm1.path.farend.15min.BBE	25 (count)	0 - 2159100
MRC-12.pmthresholds.stm1.path.farend.15min.EB	15 (count)	0 - 13305600
MRC-12.pmthresholds.stm1.path.farend.15min.ES	12 (seconds)	0 - 900
MRC-12.pmthresholds.stm1.path.farend.15min.SES	3 (seconds)	0 - 900
MRC-12.pmthresholds.stm1.path.farend.15min.UAS	10 (seconds)	0 - 900
MRC-12.pmthresholds.stm1.path.farend.1day.BBE	250 (count)	0 - 207273600
MRC-12.pmthresholds.stm1.path.farend.1day.EB	125 (count)	0 - 691200000
MRC-12.pmthresholds.stm1.path.farend.1day.ES	100 (seconds)	0 - 86400
MRC-12.pmthresholds.stm1.path.farend.1day.SES	7 (seconds)	0 - 86400
MRC-12.pmthresholds.stm1.path.farend.1day.UAS	10 (seconds)	0 - 86400
MRC-12.pmthresholds.stm1.path.nearend.15min.BBE	25 (count)	0 - 2159100
MRC-12.pmthresholds.stm1.path.nearend.15min.EB	15 (count)	0 - 7200000
MRC-12.pmthresholds.stm1.path.nearend.15min.ES	12 (seconds)	0 - 900
MRC-12.pmthresholds.stm1.path.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
MRC-12.pmthresholds.stm1.path.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000

Table C-14 MRC-12 Card Default Settings (continued)

Default Name	Default Value	Default Domain
MRC-12.pmthresholds.stm1.path.nearend.15min.PJCDIFF	60 (count)	0 - 1200
MRC-12.pmthresholds.stm1.path.nearend.15min.PJCS-PDET	100 (seconds)	0 - 7200000
MRC-12.pmthresholds.stm1.path.nearend.15min.PJCS-PGEN	100 (seconds)	0 - 7200000
MRC-12.pmthresholds.stm1.path.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
MRC-12.pmthresholds.stm1.path.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
MRC-12.pmthresholds.stm1.path.nearend.15min.SES	3 (seconds)	0 - 900
MRC-12.pmthresholds.stm1.path.nearend.15min.UAS	10 (seconds)	0 - 900
MRC-12.pmthresholds.stm1.path.nearend.1day.BBE	250 (count)	0 - 207273600
MRC-12.pmthresholds.stm1.path.nearend.1day.EB	125 (count)	0 - 691200000
MRC-12.pmthresholds.stm1.path.nearend.1day.ES	100 (seconds)	0 - 86400
MRC-12.pmthresholds.stm1.path.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
MRC-12.pmthresholds.stm1.path.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
MRC-12.pmthresholds.stm1.path.nearend.1day.PJCDIFF	5760 (count)	0 - 115200
MRC-12.pmthresholds.stm1.path.nearend.1day.PJCS-PDET	9600 (seconds)	0 - 691200000
MRC-12.pmthresholds.stm1.path.nearend.1day.PJCS-PGEN	9600 (seconds)	0 - 691200000
MRC-12.pmthresholds.stm1.path.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
MRC-12.pmthresholds.stm1.path.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
MRC-12.pmthresholds.stm1.path.nearend.1day.SES	7 (seconds)	0 - 86400
MRC-12.pmthresholds.stm1.path.nearend.1day.UAS	10 (seconds)	0 - 86400
MRC-12.pmthresholds.stm1.rs.nearend.15min.BBE	10000 (count)	0 - 138600
MRC-12.pmthresholds.stm1.rs.nearend.15min.EB	10000 (count)	0 - 138600
MRC-12.pmthresholds.stm1.rs.nearend.15min.ES	500 (seconds)	0 - 900
MRC-12.pmthresholds.stm1.rs.nearend.15min.SEFS	500 (seconds)	0 - 900
MRC-12.pmthresholds.stm1.rs.nearend.15min.SES	500 (seconds)	0 - 900
MRC-12.pmthresholds.stm1.rs.nearend.15min.UAS	3 (seconds)	0 - 900
MRC-12.pmthresholds.stm1.rs.nearend.1day.BBE	100000 (count)	0 - 13305600
MRC-12.pmthresholds.stm1.rs.nearend.1day.EB	100000 (count)	0 - 13305600
MRC-12.pmthresholds.stm1.rs.nearend.1day.ES	5000 (seconds)	0 - 86400
MRC-12.pmthresholds.stm1.rs.nearend.1day.SEFS	5000 (seconds)	0 - 86400
MRC-12.pmthresholds.stm1.rs.nearend.1day.SES	5000 (seconds)	0 - 86400
MRC-12.pmthresholds.stm1.rs.nearend.1day.UAS	10 (seconds)	0 - 86400
MRC-12.pmthresholds.stm16.ms.farend.15min.BBE	21260 (count)	0 - 2212200
MRC-12.pmthresholds.stm16.ms.farend.15min.EB	21260 (count)	0 - 2212200
MRC-12.pmthresholds.stm16.ms.farend.15min.ES	87 (seconds)	0 - 900
MRC-12.pmthresholds.stm16.ms.farend.15min.SES	1 (seconds)	0 - 900
MRC-12.pmthresholds.stm16.ms.farend.15min.UAS	3 (seconds)	0 - 900

Table C-14 MRC-12 Card Default Settings (continued)

Default Name	Default Value	Default Domain
MRC-12.pmthresholds.stm16.ms.farend.1day.BBE	212600 (count)	0 - 212371200
MRC-12.pmthresholds.stm16.ms.farend.1day.EB	212600 (count)	0 - 212371200
MRC-12.pmthresholds.stm16.ms.farend.1day.ES	864 (seconds)	0 - 86400
MRC-12.pmthresholds.stm16.ms.farend.1day.SES	4 (seconds)	0 - 86400
MRC-12.pmthresholds.stm16.ms.farend.1day.UAS	10 (seconds)	0 - 86400
MRC-12.pmthresholds.stm16.ms.nearend.15min.BBE	21260 (count)	0 - 2212200
MRC-12.pmthresholds.stm16.ms.nearend.15min.EB	21260 (count)	0 - 2212200
MRC-12.pmthresholds.stm16.ms.nearend.15min.ES	87 (seconds)	0 - 900
MRC-12.pmthresholds.stm16.ms.nearend.15min.PSC	1 (count)	0 - 600
MRC-12.pmthresholds.stm16.ms.nearend.15min.PSC-R	1 (count)	0 - 600
MRC-12.pmthresholds.stm16.ms.nearend.15min.PSC-S	1 (count)	0 - 600
MRC-12.pmthresholds.stm16.ms.nearend.15min.PSC-W	1 (count)	0 - 600
MRC-12.pmthresholds.stm16.ms.nearend.15min.PSD	300 (seconds)	0 - 900
MRC-12.pmthresholds.stm16.ms.nearend.15min.PSD-R	300 (seconds)	0 - 900
MRC-12.pmthresholds.stm16.ms.nearend.15min.PSD-S	300 (seconds)	0 - 900
MRC-12.pmthresholds.stm16.ms.nearend.15min.PSD-W	300 (seconds)	0 - 900
MRC-12.pmthresholds.stm16.ms.nearend.15min.SES	1 (seconds)	0 - 900
MRC-12.pmthresholds.stm16.ms.nearend.15min.UAS	3 (seconds)	0 - 900
MRC-12.pmthresholds.stm16.ms.nearend.1day.BBE	212600 (count)	0 - 212371200
MRC-12.pmthresholds.stm16.ms.nearend.1day.EB	212600 (count)	0 - 212371200
MRC-12.pmthresholds.stm16.ms.nearend.1day.ES	864 (seconds)	0 - 86400
MRC-12.pmthresholds.stm16.ms.nearend.1day.PSC	5 (count)	0 - 57600
MRC-12.pmthresholds.stm16.ms.nearend.1day.PSC-R	5 (count)	0 - 57600
MRC-12.pmthresholds.stm16.ms.nearend.1day.PSC-S	5 (count)	0 - 57600
MRC-12.pmthresholds.stm16.ms.nearend.1day.PSC-W	5 (count)	0 - 57600
MRC-12.pmthresholds.stm16.ms.nearend.1day.PSD	600 (seconds)	0 - 86400
MRC-12.pmthresholds.stm16.ms.nearend.1day.PSD-R	600 (seconds)	0 - 86400
MRC-12.pmthresholds.stm16.ms.nearend.1day.PSD-S	600 (seconds)	0 - 86400
MRC-12.pmthresholds.stm16.ms.nearend.1day.PSD-W	600 (seconds)	0 - 86400
MRC-12.pmthresholds.stm16.ms.nearend.1day.SES	4 (seconds)	0 - 86400
MRC-12.pmthresholds.stm16.ms.nearend.1day.UAS	10 (seconds)	0 - 86400
MRC-12.pmthresholds.stm16.path.farend.15min.BBE	25 (count)	0 - 2159100
MRC-12.pmthresholds.stm16.path.farend.15min.EB	15 (count)	0 - 13305600
MRC-12.pmthresholds.stm16.path.farend.15min.ES	12 (seconds)	0 - 900
MRC-12.pmthresholds.stm16.path.farend.15min.SES	3 (seconds)	0 - 900
MRC-12.pmthresholds.stm16.path.farend.15min.UAS	10 (seconds)	0 - 900

Table C-14 MRC-12 Card Default Settings (continued)

Default Name	Default Value	Default Domain
MRC-12.pmthresholds.stm16.path.farend.1day.BBE	250 (count)	0 - 207273600
MRC-12.pmthresholds.stm16.path.farend.1day.EB	125 (count)	0 - 691200000
MRC-12.pmthresholds.stm16.path.farend.1day.ES	100 (seconds)	0 - 86400
MRC-12.pmthresholds.stm16.path.farend.1day.SES	7 (seconds)	0 - 86400
MRC-12.pmthresholds.stm16.path.farend.1day.UAS	10 (seconds)	0 - 86400
MRC-12.pmthresholds.stm16.path.nearend.15min.BBE	25 (count)	0 - 2159100
MRC-12.pmthresholds.stm16.path.nearend.15min.EB	15 (count)	0 - 7200000
MRC-12.pmthresholds.stm16.path.nearend.15min.ES	12 (seconds)	0 - 900
MRC-12.pmthresholds.stm16.path.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
MRC-12.pmthresholds.stm16.path.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
MRC-12.pmthresholds.stm16.path.nearend.15min.PJCDIFF	60 (count)	0 - 1200
MRC-12.pmthresholds.stm16.path.nearend.15min.PJCS-PDET	100 (seconds)	0 - 7200000
MRC-12.pmthresholds.stm16.path.nearend.15min.PJCS-PGEN	100 (seconds)	0 - 7200000
MRC-12.pmthresholds.stm16.path.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
MRC-12.pmthresholds.stm16.path.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
MRC-12.pmthresholds.stm16.path.nearend.15min.SES	3 (seconds)	0 - 900
MRC-12.pmthresholds.stm16.path.nearend.15min.UAS	10 (seconds)	0 - 900
MRC-12.pmthresholds.stm16.path.nearend.1day.BBE	250 (count)	0 - 207273600
MRC-12.pmthresholds.stm16.path.nearend.1day.EB	125 (count)	0 - 691200000
MRC-12.pmthresholds.stm16.path.nearend.1day.ES	100 (seconds)	0 - 86400
MRC-12.pmthresholds.stm16.path.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
MRC-12.pmthresholds.stm16.path.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
MRC-12.pmthresholds.stm16.path.nearend.1day.PJCDIFF	5760 (count)	0 - 115200
MRC-12.pmthresholds.stm16.path.nearend.1day.PJCS-PDET	9600 (seconds)	0 - 691200000
MRC-12.pmthresholds.stm16.path.nearend.1day.PJCS-PGEN	9600 (seconds)	0 - 691200000
MRC-12.pmthresholds.stm16.path.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
MRC-12.pmthresholds.stm16.path.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
MRC-12.pmthresholds.stm16.path.nearend.1day.SES	7 (seconds)	0 - 86400
MRC-12.pmthresholds.stm16.path.nearend.1day.UAS	10 (seconds)	0 - 86400
MRC-12.pmthresholds.stm16.rs.nearend.15min.BBE	10000 (count)	0 - 2151900
MRC-12.pmthresholds.stm16.rs.nearend.15min.EB	10000 (count)	0 - 2151900
MRC-12.pmthresholds.stm16.rs.nearend.15min.ES	500 (seconds)	0 - 900
MRC-12.pmthresholds.stm16.rs.nearend.15min.SEFS	500 (seconds)	0 - 900
MRC-12.pmthresholds.stm16.rs.nearend.15min.SES	500 (seconds)	0 - 900
MRC-12.pmthresholds.stm16.rs.nearend.15min.UAS	3 (seconds)	0 - 900
MRC-12.pmthresholds.stm16.rs.nearend.1day.BBE	100000 (count)	0 - 206582400

Table C-14 MRC-12 Card Default Settings (continued)

Default Name	Default Value	Default Domain
MRC-12.pmthresholds.stm16.rs.nearend.1day.EB	100000 (count)	0 - 206582400
MRC-12.pmthresholds.stm16.rs.nearend.1day.ES	5000 (seconds)	0 - 86400
MRC-12.pmthresholds.stm16.rs.nearend.1day.SEFS	5000 (seconds)	0 - 86400
MRC-12.pmthresholds.stm16.rs.nearend.1day.SES	5000 (seconds)	0 - 86400
MRC-12.pmthresholds.stm16.rs.nearend.1day.UAS	10 (seconds)	0 - 86400
MRC-12.pmthresholds.stm4.ms.farend.15min.BBE	5315 (count)	0 - 552600
MRC-12.pmthresholds.stm4.ms.farend.15min.EB	5315 (count)	0 - 552600
MRC-12.pmthresholds.stm4.ms.farend.15min.ES	87 (seconds)	0 - 900
MRC-12.pmthresholds.stm4.ms.farend.15min.SES	1 (seconds)	0 - 900
MRC-12.pmthresholds.stm4.ms.farend.15min.UAS	3 (seconds)	0 - 900
MRC-12.pmthresholds.stm4.ms.farend.1day.BBE	53150 (count)	0 - 53049600
MRC-12.pmthresholds.stm4.ms.farend.1day.EB	53150 (count)	0 - 53049600
MRC-12.pmthresholds.stm4.ms.farend.1day.ES	864 (seconds)	0 - 86400
MRC-12.pmthresholds.stm4.ms.farend.1day.SES	4 (seconds)	0 - 86400
MRC-12.pmthresholds.stm4.ms.farend.1day.UAS	10 (seconds)	0 - 86400
MRC-12.pmthresholds.stm4.ms.nearend.15min.BBE	5315 (count)	0 - 552600
MRC-12.pmthresholds.stm4.ms.nearend.15min.EB	5315 (count)	0 - 552600
MRC-12.pmthresholds.stm4.ms.nearend.15min.ES	87 (seconds)	0 - 900
MRC-12.pmthresholds.stm4.ms.nearend.15min.PSC	1 (count)	0 - 600
MRC-12.pmthresholds.stm4.ms.nearend.15min.PSC-W	1 (count)	0 - 600
MRC-12.pmthresholds.stm4.ms.nearend.15min.PSD	300 (seconds)	0 - 900
MRC-12.pmthresholds.stm4.ms.nearend.15min.PSD-W	300 (seconds)	0 - 900
MRC-12.pmthresholds.stm4.ms.nearend.15min.SES	1 (seconds)	0 - 900
MRC-12.pmthresholds.stm4.ms.nearend.15min.UAS	3 (seconds)	0 - 900
MRC-12.pmthresholds.stm4.ms.nearend.1day.BBE	53150 (count)	0 - 53049600
MRC-12.pmthresholds.stm4.ms.nearend.1day.EB	53150 (count)	0 - 53049600
MRC-12.pmthresholds.stm4.ms.nearend.1day.ES	864 (seconds)	0 - 86400
MRC-12.pmthresholds.stm4.ms.nearend.1day.PSC	5 (count)	0 - 57600
MRC-12.pmthresholds.stm4.ms.nearend.1day.PSC-W	5 (count)	0 - 57600
MRC-12.pmthresholds.stm4.ms.nearend.1day.PSD	600 (seconds)	0 - 86400
MRC-12.pmthresholds.stm4.ms.nearend.1day.PSD-W	600 (seconds)	0 - 86400
MRC-12.pmthresholds.stm4.ms.nearend.1day.SES	4 (seconds)	0 - 86400
MRC-12.pmthresholds.stm4.ms.nearend.1day.UAS	10 (seconds)	0 - 86400
MRC-12.pmthresholds.stm4.path.farend.15min.BBE	25 (count)	0 - 2159100
MRC-12.pmthresholds.stm4.path.farend.15min.EB	15 (count)	0 - 13305600
MRC-12.pmthresholds.stm4.path.farend.15min.ES	12 (seconds)	0 - 900

Table C-14 MRC-12 Card Default Settings (continued)

Default Name	Default Value	Default Domain
MRC-12.pmthresholds.stm4.path.farend.15min.SES	3 (seconds)	0 - 900
MRC-12.pmthresholds.stm4.path.farend.15min.UAS	10 (seconds)	0 - 900
MRC-12.pmthresholds.stm4.path.farend.1day.BBE	250 (count)	0 - 207273600
MRC-12.pmthresholds.stm4.path.farend.1day.EB	125 (count)	0 - 691200000
MRC-12.pmthresholds.stm4.path.farend.1day.ES	100 (seconds)	0 - 86400
MRC-12.pmthresholds.stm4.path.farend.1day.SES	7 (seconds)	0 - 86400
MRC-12.pmthresholds.stm4.path.farend.1day.UAS	10 (seconds)	0 - 86400
MRC-12.pmthresholds.stm4.path.nearend.15min.BBE	25 (count)	0 - 2159100
MRC-12.pmthresholds.stm4.path.nearend.15min.EB	15 (count)	0 - 7200000
MRC-12.pmthresholds.stm4.path.nearend.15min.ES	12 (seconds)	0 - 900
MRC-12.pmthresholds.stm4.path.nearend.15min.NPJC-PDET	60 (count)	0 - 691200000
MRC-12.pmthresholds.stm4.path.nearend.15min.NPJC-PGEN	60 (count)	0 - 691200000
MRC-12.pmthresholds.stm4.path.nearend.15min.PJCDIFF	60 (count)	0 - 1200
MRC-12.pmthresholds.stm4.path.nearend.15min.PJCS-PDET	100 (seconds)	0 - 7200000
MRC-12.pmthresholds.stm4.path.nearend.15min.PJCS-PGEN	100 (seconds)	0 - 7200000
MRC-12.pmthresholds.stm4.path.nearend.15min.PPJC-PDET	60 (count)	0 - 691200000
MRC-12.pmthresholds.stm4.path.nearend.15min.PPJC-PGEN	60 (count)	0 - 691200000
MRC-12.pmthresholds.stm4.path.nearend.15min.SES	3 (seconds)	0 - 900
MRC-12.pmthresholds.stm4.path.nearend.15min.UAS	10 (seconds)	0 - 900
MRC-12.pmthresholds.stm4.path.nearend.1day.BBE	250 (count)	0 - 207273600
MRC-12.pmthresholds.stm4.path.nearend.1day.EB	125 (count)	0 - 691200000
MRC-12.pmthresholds.stm4.path.nearend.1day.ES	100 (seconds)	0 - 86400
MRC-12.pmthresholds.stm4.path.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
MRC-12.pmthresholds.stm4.path.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
MRC-12.pmthresholds.stm4.path.nearend.1day.PJCDIFF	5760 (count)	0 - 115200
MRC-12.pmthresholds.stm4.path.nearend.1day.PJCS-PDET	9600 (seconds)	0 - 691200000
MRC-12.pmthresholds.stm4.path.nearend.1day.PJCS-PGEN	9600 (seconds)	0 - 691200000
MRC-12.pmthresholds.stm4.path.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
MRC-12.pmthresholds.stm4.path.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
MRC-12.pmthresholds.stm4.path.nearend.1day.SES	7 (seconds)	0 - 86400
MRC-12.pmthresholds.stm4.path.nearend.1day.UAS	10 (seconds)	0 - 86400
MRC-12.pmthresholds.stm4.rs.nearend.15min.BBE	10000 (count)	0 - 553500
MRC-12.pmthresholds.stm4.rs.nearend.15min.EB	10000 (count)	0 - 553500
MRC-12.pmthresholds.stm4.rs.nearend.15min.ES	500 (seconds)	0 - 900
MRC-12.pmthresholds.stm4.rs.nearend.15min.SEFS	500 (seconds)	0 - 900
MRC-12.pmthresholds.stm4.rs.nearend.15min.SES	500 (seconds)	0 - 900

Table C-14 MRC-12 Card Default Settings (continued)

Default Name	Default Value	Default Domain
MRC-12.pmthresholds.stm4.rs.nearend.15min.UAS	3 (seconds)	0 - 900
MRC-12.pmthresholds.stm4.rs.nearend.1day.BBE	100000 (count)	0 - 53136000
MRC-12.pmthresholds.stm4.rs.nearend.1day.EB	100000 (count)	0 - 53136000
MRC-12.pmthresholds.stm4.rs.nearend.1day.ES	5000 (seconds)	0 - 86400
MRC-12.pmthresholds.stm4.rs.nearend.1day.SEFS	5000 (seconds)	0 - 86400
MRC-12.pmthresholds.stm4.rs.nearend.1day.SES	5000 (seconds)	0 - 86400
MRC-12.pmthresholds.stm4.rs.nearend.1day.UAS	10 (seconds)	0 - 86400

C.2.3.15 FC_MR-4 Card Default Settings

Table C-15 lists the FC_MR-4 (Fibre Channel) card default settings.

Table C-15 FC_MR-4 Card Default Settings

Default Name	Default Value	Default Domain
FC-MR.config.card.Mode	Fibre Channel/FICON Enhanced	Fibre Channel Line Rate, Fibre Channel/FICON Enhanced when //.port.MediaType Undefined; Fibre Channel/FICON Enhanced when //.port.MediaType FICON - 1 Gbps ISL, FICON - 2 Gbps ISL; Fibre Channel Line Rate, Fibre Channel/FICON Enhanced when //.port.MediaType Fibre Channel - 1 Gbps ISL, Fibre Channel - 2 Gbps ISL
FC-MR.config.port.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
FC-MR.config.port.distanceExtension.AutoadjustGFPBufferThreshold	TRUE	TRUE, FALSE
FC-MR.config.port.distanceExtension.AutoDetect	TRUE	TRUE, FALSE
FC-MR.config.port.distanceExtension.NumCredits	32	2 - 256
FC-MR.config.port.distanceExtension.NumGFPBuffers	16	16, 32, 48 .. 1200
FC-MR.config.port.DistanceExtensionVsLinkRecovery	Distance Extension	Neither Distance Extension nor Link Recovery, Distance Extension, LinkRecovery when MediaType Undefined; Distance Extension when MediaType FICON - 1 Gbps ISL, FICON - 2 Gbps ISL; Neither Distance Extension nor Link Recovery, Distance Extension, LinkRecovery when MediaType Fibre Channel - 1 Gbps ISL, Fibre Channel - 2 Gbps ISL

Table C-15 FC_MR-4 Card Default Settings (continued)

Default Name	Default Value	Default Domain
FC-MR.config.port.enhancedFibreChannelFicon.IngressIdleFiltering	TRUE	TRUE, FALSE
FC-MR.config.port.enhancedFibreChannelFicon.MaxFrameSize	2148	2148, 2152, 2156, 2160, 2164, 2168, 2172
FC-MR.config.port.MediaType	Undefined	Fibre Channel - 1 Gbps ISL, Fibre Channel - 2 Gbps ISL, FICON - 1 Gbps ISL, FICON - 2 Gbps ISL, Undefined
FC-MR.config.port.State	locked, disabled	unlocked, locked, disabled, locked, maintenance, unlocked, automaticInService

C.3 Node Default Settings

Table C-16 on page C-47 lists the node-level default settings for the Cisco ONS 15454 SDH. Cisco provides the following user-configurable defaults for each Cisco ONS 15454 SDH node:

- Circuit settings—Set the administrative state, subnetwork connection protection (SNCP) circuit threshold levels for signal degradation and failure, SNCP reversion time, and whether SNCP circuits are revertive by default.
- General settings—Set general node management defaults, including whether to use Daylight Savings Time (DST), the IP address of the NTP/SNTP server to be used, the time zone where the node is located, the SD path BER value, and the defaults description.
- Power Monitor settings—Set default voltage thresholds for the node.
- Network settings—Set whether to prevent display of node IP addresses in CTC (applicable for all users except Superusers); default gateway node type; whether to raise an alarm when the backplane LAN cable is disconnected; and whether to display the IP address in the LCD in an editable mode (in which you can change the IP address directly from LCD screen), to display the IP address on the LCD as read-only, or to suppress display of the IP on the LCD entirely.
- OSI settings—Set Open System Interconnection (OSI) main setup, generic routing encapsulation (GRE) tunnel, link access protocol on the D channel (LAP-D), router subnet, and TID address resolution protocol (TARP) settings.
- Linear Multiplex Section Protection (LMSP) settings—Set whether or not protected circuits have bidirectional switching, are revertive, and what the reversion time is.
- MS-SPRing protection settings—Set whether MS-SPRing-protected circuits are revertive, and what the reversion time is, at both the ring and span levels.
- Legal Disclaimer—Set the legal disclaimer that warns users at the login screen about the possible legal or contractual ramifications of accessing equipment, systems, or networks without authorization.
- Security Grant Permissions—Set default user security levels for activating/reverting software, performance monitoring data clearing, database restoring, and retrieving audit logs.
- Security DataComm settings—Set default security settings for TCC Ethernet IP address and IP netmask, and CTC backplane IP suppression; set secure mode on and secure mode locked (for TCC2P cards only).

- Security Access settings—Set default security settings for LAN access, shell access, serial craft access, element management system (EMS) access (including Internet Inter-Object Request Broker Protocol [IIOP] listener port number), TL1 access, and SNMP access.
- Security RADIUS settings—Set default RADIUS server settings for accounting port number, authentication port number, and whether to enable the node as a final authenticator.
- Security Policy settings—Set the allowable failed logins before lockout, idle user timeout for each user-level, optional lockout duration or manual unlock enabled, password reuse and change frequency policies, number of characters difference between the old and new password, password aging by security level, enforced single concurrent session per user, and option to disable inactive user after a set inactivity period.
- BITS Timing settings—Set the AIS threshold, Admin SSM, coding, facility type, framing, state, and Sa bit (the overhead bit that will carry the SSM) for building integrated timing supply 1 (BITS-1) and BITS2 timing.
- General Timing settings—Set the mode (External, Line, or Mixed), revertive, and reversion time.

Note Any node level defaults changed using the **Provisioning > Defaults** tab, changes existing node level provisioning. Although this is service affecting, it depends on the type of defaults changed, for example, general, and all timing and security attributes. The "Changing default values for some node level attributes overrides the current provisioning." message is displayed. The Side Effects column of the Defaults editor (right-click a column header and select **Show Column > Side Effects**) explains the effect of changing the default values. However, when the card level defaults are changed using the **Provisioning > Defaults** tab, existing card provisioning remains unaffected.

Note For more information about each individual node setting, refer to the "Change Node Settings" chapter of the *Cisco ONS 15454 SDH Procedure Guide*.

Table C-16 Node Default Settings

Default Name	Default Value	Default Domain
NODE.circuits.sncp.HO_SDBER	1.00E-06	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
NODE.circuits.sncp.HO_SFBER	1.00E-04	1E-3, 1E-4, 1E-5
NODE.circuits.sncp.LO_SDBER	1.00E-06	1E-5, 1E-6, 1E-7, 1E-8
NODE.circuits.sncp.LO_SFBER	1.00E-04	1E-3, 1E-4, 1E-5
NODE.circuits.sncp.ReversionTime	5.0 (minutes)	0.5, 1.0, 1.5 .. 12.0
NODE.circuits.sncp.Revertive	FALSE	TRUE, FALSE
NODE.circuits.State	unlocked, automaticInService	unlocked, locked, disabled, locked, maintenance, unlocked, automaticInService
NODE.general.DefaultsDescription	Factory Defaults	Free form field

Table C-16 Node Default Settings (continued)

Default Name	Default Value	Default Domain
NODE.general.NtpSntpServer	0.0.0.0	IP Address
NODE.general.ReportLoopbackConditionsOnUnlocked,MaintenancePorts	FALSE	FALSE, TRUE
NODE.general.TimeZone	(GMT-08:00) Pacific Time (US & Canada), Tijuana	(For applicable time zones, see Table C-17 on page C-55.)
NODE.general.UseDST	TRUE	TRUE, FALSE
NODE.network.general.AlarmMissingBackplaneLAN	FALSE	TRUE, FALSE
NODE.network.general.CtcIpDisplaySuppression	FALSE	TRUE, FALSE
NODE.network.general.GatewaySettings	None	LeaveAsIs, None, ENE, GNE, ProxyOnlyNode
NODE.network.general.LcdIpSetting	Allow Configuration	Allow Configuration, Display Only, Suppress Display
NODE.osi.greTunnel.OspfCost	110	110, 111, 112 .. 65535
NODE.osi.greTunnel.SubnetMask	24 (bits)	8, 9, 10 .. 32
NODE.osi.lapd.Mode	AITS	AITS, UITS
NODE.osi.lapd.MTU	512	512, 513, 514 .. 1500
NODE.osi.lapd.Role	Network	Network, User
NODE.osi.lapd.T200	200 (ms)	200, 300, 400 .. 20000
NODE.osi.lapd.T203	10000 (ms)	4000, 4100, 4200 .. 120000
NODE.osi.mainSetup.L1L2LSPBufferSize	512 (bytes)	512 - 1500
NODE.osi.mainSetup.L1LSPBufferSize	512 (bytes)	512 - 1500
NODE.osi.mainSetup.NodeRoutingMode	Intermediate System Level 1	End System, Intermediate System Level 1, Intermediate System Level 1/Level 2
NODE.osi.subnet.DISPriority	63	1, 2, 3 .. 127
NODE.osi.subnet.ESH	10 (sec)	10, 20, 30 .. 1000
NODE.osi.subnet.GCCISISCost	60	1, 2, 3 .. 63
NODE.osi.subnet.IIH	3 (sec)	1, 2, 3 .. 600
NODE.osi.subnet.ISH	10 (sec)	10, 20, 30 .. 1000
NODE.osi.subnet.LANISISCost	20	1, 2, 3 .. 63
NODE.osi.subnet.LDCCISISCost	40	1, 2, 3 .. 63
NODE.osi.subnet.OSCISISCost	60	1, 2, 3 .. 63
NODE.osi.subnet.SDCCISISCost	60	1, 2, 3 .. 63

Table C-16 Node Default Settings (continued)

Default Name	Default Value	Default Domain
NODE.osi.tarp.L1DataCache	TRUE	FALSE, TRUE
NODE.osi.tarp.L2DataCache	FALSE	FALSE, TRUE
NODE.osi.tarp.LANStormSuppression	TRUE	FALSE, TRUE
NODE.osi.tarp.LDB	TRUE	FALSE, TRUE
NODE.osi.tarp.LDBEntry	5 (min)	1 - 10
NODE.osi.tarp.LDBFlush	5 (min)	0 - 1440
NODE.osi.tarp.PDUsL1Propagation	TRUE	FALSE, TRUE
NODE.osi.tarp.PDUsL2Propagation	TRUE	FALSE, TRUE
NODE.osi.tarp.PDUsOrigination	TRUE	FALSE, TRUE
NODE.osi.tarp.T1Timer	15 (sec)	0 - 3600
NODE.osi.tarp.T2Timer	25 (sec)	0 - 3600
NODE.osi.tarp.T3Timer	40 (sec)	0 - 3600
NODE.osi.tarp.T4Timer	20 (sec)	0 - 3600
NODE.osi.tarp.Type4PDUDelay	0 (sec)	0 - 255
NODE.powerMonitor.EHIBATVG_48V	-56.5 (Vdc)	-40.5, -41.0, -41.5 .. -57.0
NODE.powerMonitor.EHIBATVG_60V	-72.0 (Vdc)	-50.0, -50.5, -51.0 .. -72.0
NODE.powerMonitor.ELWBATVG_48V	-40.5 (Vdc)	-40.5, -41.0, -41.5 .. -56.5
NODE.powerMonitor.ELWBATVG_60V	-50.0 (Vdc)	-50.0, -50.5, -51.0 .. -72.0
NODE.protection.lmsp.BidirectionalSwitching	FALSE	TRUE, FALSE
NODE.protection.lmsp.ReversionTime	5.0 (minutes)	0.5, 1.0, 1.5 .. 12.0
NODE.protection.lmsp.Revertive	FALSE	TRUE, FALSE
NODE.protection.msspr.RingReversionTime	5.0 (minutes)	0.5, 1.0, 1.5 .. 12.0
NODE.protection.msspr.RingRevertive	TRUE	TRUE, FALSE
NODE.protection.msspr.SpanReversionTime	5.0 (minutes)	0.5, 1.0, 1.5 .. 12.0
NODE.protection.msspr.SpanRevertive	TRUE	TRUE, FALSE
NODE.protection.splitter.ReversionTime	5.0 (minutes)	0.5, 1.0, 1.5 .. 12.0
NODE.protection.splitter.Revertive	FALSE	TRUE, FALSE
NODE.protection.ycable.ReversionTime	5.0 (minutes)	0.5, 1.0, 1.5 .. 12.0
NODE.protection.ycable.Revertive	FALSE	TRUE, FALSE

Table C-16 Node Default Settings (continued)

Default Name	Default Value	Default Domain
NODE.security.dataComm.CtcBackplaneIpDisplaySuppression	TRUE	FALSE, TRUE when isSecureModeSupportedOnControlCard TRUE; (NOT SUPPORTED) when isSecureModeSupportedOnControlCard FALSE
NODE.security.dataComm.DefaultTCCEthernetIP	10.0.0.1	IP Address
NODE.security.dataComm.DefaultTCCEthernetIPNetmask	24 (bits)	8, 9, 10 .. 32
NODE.security.dataComm.isSecureModeSupportedOnControlCard	TRUE	FALSE, TRUE
NODE.security.dataComm.LcdBackplaneIpSetting	Display Only	Allow Configuration, Display Only, Suppress Display when isSecureModeSupportedOnControlCard TRUE; (NOT SUPPORTED) when isSecureModeSupportedOnControlCard FALSE
NODE.security.dataComm.SecureModeLocked	FALSE	FALSE, TRUE when isSecureModeSupportedOnControlCard TRUE; (NOT SUPPORTED) when isSecureModeSupportedOnControlCard FALSE
NODE.security.dataComm.SecureModeOn (May reboot node)	FALSE	FALSE, TRUE when isSecureModeSupportedOnControlCard TRUE; (NOT SUPPORTED) when isSecureModeSupportedOnControlCard FALSE
NODE.security.emsAccess.AccessState	NonSecure	NonSecure, Secure
NODE.security.emsAccess.IIOPListenerPort (May reboot node)	57790 (port #)	0 - 65535
NODE.security.grantPermission.ActivateRevertSoftware	Superuser	Provisioning, Superuser
NODE.security.grantPermission.PMClearingPrivilege	Provisioning	Provisioning, Superuser

Table C-16 Node Default Settings (continued)

Default Name	Default Value	Default Domain
NODE.security.grantPermission.RestoreDB	Superuser	Provisioning, Superuser
NODE.security.grantPermission.RetrieveAuditLog	Superuser	Provisioning, Superuser
NODE.security.idleUserTimeout.Maintenance	01:00 (hours:mins)	00:00, 00:01, 00:02 .. 16:39
NODE.security.idleUserTimeout.Provisioning	00:30 (hours:mins)	00:00, 00:01, 00:02 .. 16:39
NODE.security.idleUserTimeout.Retrieve	00:00 (hours:mins)	00:00, 00:01, 00:02 .. 16:39
NODE.security.idleUserTimeout.Superuser	00:15 (hours:mins)	00:00, 00:01, 00:02 .. 16:39
NODE.security.lanAccess.LANAccess (May disconnect CTC from node)	Front & Backplane	No LAN Access, Front Only, Backplane Only, Front & Backplane
NODE.security.lanAccess.RestoreTimeout	5 (minutes)	0 - 60
NODE.security.legalDisclaimer.LoginWarningMessage	<html> WARNING This system is restricted to authorized users for business purposes. Unauthorized<p>access is a violation of the law. This service may be monitored for administrative<p>and security reasons. By proceeding, you consent to this monitoring.	Free form field
NODE.security.other.DisableInactiveUser	FALSE	FALSE, TRUE

Table C-16 Node Default Settings (continued)

Default Name	Default Value	Default Domain
NODE.security.other.InactiveDuration	45 (days)	1, 2, 3 .. 99 when DisableInactiveUser TRUE; 45 when DisableInactiveUser FALSE
NODE.security.other.SingleSessionPerUser	FALSE	TRUE, FALSE
NODE.security.passwordAging.EnforcePasswordAging	FALSE	TRUE, FALSE
NODE.security.passwordAging.maintenance.AgingPeriod	45 (days)	20 - 90
NODE.security.passwordAging.maintenance.WarningPeriod	5 (days)	2 - 20
NODE.security.passwordAging.provisioning.AgingPeriod	45 (days)	20 - 90
NODE.security.passwordAging.provisioning.WarningPeriod	5 (days)	2 - 20
NODE.security.passwordAging.retrieve.AgingPeriod	45 (days)	20 - 90
NODE.security.passwordAging.retrieve.WarningPeriod	5 (days)	2 - 20
NODE.security.passwordAging.superuser.AgingPeriod	45 (days)	20 - 90
NODE.security.passwordAging.superuser.WarningPeriod	5 (days)	2 - 20
NODE.security.passwordChange.CannotChangeNewPassword	FALSE	TRUE, FALSE
NODE.security.passwordChange.CannotChangeNewPasswordForNDays	20 (days)	20 - 95
NODE.security.passwordChange.NewPasswordMustDifferFromOldByNCharacters	1 (characters)	1 - 5
NODE.security.passwordChange.PreventReusingLastNPasswords	1 (times)	1 - 10
NODE.security.passwordChange.RequirePasswordChangeOnFirstLoginToNewAccount	FALSE	TRUE, FALSE
NODE.security.radiusServer.AccountingPort	1813 (port)	0 - 32767
NODE.security.radiusServer.AuthenticationPort	1812 (port)	0 - 32767
NODE.security.radiusServer.EnableNodeAsFinalAuthenticator	TRUE	FALSE, TRUE
NODE.security.serialCraftAccess.EnableCraftPort	TRUE	TRUE, FALSE
NODE.security.shellAccess.AccessState	NonSecure	Disabled, NonSecure, Secure
NODE.security.shellAccess.EnableShellPassword	FALSE	TRUE, FALSE
NODE.security.shellAccess.TelnetPort	23	23 - 9999
NODE.security.snmpAccess.AccessState	NonSecure	Disabled, NonSecure
NODE.security.tl1Access.AccessState	NonSecure	Disabled, NonSecure, Secure
NODE.security.userLockout.FailedLoginsAllowedBeforeLockout	5 (times)	0 - 10
NODE.security.userLockout.LockoutDuration	00:30 (mins:secs)	00:00, 00:05, 00:10 .. 10:00
NODE.security.userLockout.ManualUnlockBySuperuser	FALSE	TRUE, FALSE
NODE.timing.bits-1.AdminSSMIn	STU	G811, STU, G812T, G812L, SETS, DUS

Table C-16 Node Default Settings (continued)

Default Name	Default Value	Default Domain
NODE.timing.bits-1.AISThreshold	DUS	G811, STU, G812T, G812L, SETS, DUS
NODE.timing.bits-1.Coding	HDB3	HDB3, AMI when FacilityType E1; N/A when FacilityType 2MHz; AMI when FacilityType 64kHz+8kHz
NODE.timing.bits-1.CodingOut	HDB3	HDB3, AMI when FacilityTypeOut E1; N/A when FacilityTypeOut 2MHz; AMI when FacilityTypeOut 6MHz
NODE.timing.bits-1.FacilityType	E1	E1, 64kHz+8kHz, 2MHz
NODE.timing.bits-1.FacilityTypeOut	E1	E1, 6MHz, 2MHz
NODE.timing.bits-1.Framing	FAS+CAS+ CRC	FAS+CRC, FAS+CAS, FAS+CAS+CRC, FAS, Unframed when FacilityType E1; when FacilityType 2MHz; FAS+CRC, FAS+CAS, FAS+CAS+CRC, FAS, Unframed, Unframed - 2Mhz when FacilityType 64kHz+8kHz
NODE.timing.bits-1.FramingOut	FAS+CAS+ CRC	FAS+CRC, FAS+CAS, FAS+CAS+CRC, FAS, Unframed when FacilityTypeOut E1; when FacilityTypeOut 2MHz; FAS+CRC, FAS+CAS, FAS+CAS+CRC, FAS, Unframed, Unframed - 2Mhz when FacilityTypeOut 6MHz

Table C-16 Node Default Settings (continued)

Default Name	Default Value	Default Domain
NODE.timing.bits-1.Sa bit	4	4, 5, 6, 7, 8 when FacilityType E1; N/A when FacilityType 2MHz; N/A when FacilityType 64kHz+8kHz
NODE.timing.bits-1.State	unlocked	unlocked, locked, disabled
NODE.timing.bits-1.StateOut	unlocked	unlocked, locked, disabled
NODE.timing.bits-2.AdminSSMIn	STU	G811, STU, G812T, G812L, SETS, DUS
NODE.timing.bits-2.AISThreshold	DUS	G811, STU, G812T, G812L, SETS, DUS
NODE.timing.bits-2.Coding	HDB3	HDB3, AMI when FacilityType E1; N/A when FacilityType 2MHz; AMI when FacilityType 64kHz+8kHz
NODE.timing.bits-2.CodingOut	HDB3	HDB3, AMI when FacilityTypeOut E1; N/A when FacilityTypeOut 2MHz; AMI when FacilityTypeOut 6MHz
NODE.timing.bits-2.FacilityType	E1	E1, 64kHz+8kHz, 2MHz
NODE.timing.bits-2.FacilityTypeOut	E1	E1, 6MHz, 2MHz
NODE.timing.bits-2.Framing	FAS+CAS+ CRC	FAS+CRC, FAS+CAS, FAS+CAS+CRC, FAS, Unframed when FacilityType E1; when FacilityType 2MHz; FAS+CRC, FAS+CAS, FAS+CAS+CRC, FAS, Unframed, Unframed - 2Mhz when FacilityType 64kHz+8kHz

Table C-16 Node Default Settings (continued)

Default Name	Default Value	Default Domain
NODE.timing.bits-2.FramingOut	FAS+CAS+ CRC	FAS+CRC, FAS+CAS, FAS+CAS+CRC, FAS, Unframed when FacilityTypeOut E1; when FacilityTypeOut 2MHz; FAS+CRC, FAS+CAS, FAS+CAS+CRC, FAS, Unframed, Unframed - 2Mhz when FacilityTypeOut 6MHz
NODE.timing.bits-2.Sa bit	4	4, 5, 6, 7, 8 when FacilityType E1; N/A when FacilityType 2MHz; N/A when FacilityType 64kHz+8kHz
NODE.timing.bits-2.State	unlocked	unlocked, locked, disabled
NODE.timing.bits-2.StateOut	unlocked	unlocked, locked, disabled
NODE.timing.general.Mode	External	External, Line, Mixed
NODE.timing.general.ReversionTime	5.0 (minutes)	0.5, 1.0, 1.5 .. 12.0
NODE.timing.general.Revertive	FALSE	TRUE, FALSE

C.3.1 Time Zones

Table C-17 lists the time zones that apply for node time zone defaults. Time zones in the table are ordered by their relative relationships to Greenwich Mean Time (GMT), and the default values are displayed in the correct format for valid default input.

Table C-17 Time Zones

Time Zone (GMT +/– Hours)	Default Value
GMT-11:00	(GMT-11:00) Midway Islands, Samoa
GMT-10:00	(GMT-10:00) Hawaiian Islands, Tahiti
GMT-09:00	(GMT-09:00) Anchorage - Alaska
GMT-08:00	(GMT-08:00) Pacific Time (US & Canada), Tijuana
GMT-07:00	(GMT-07:00) Mountain Time (US & Canada)
GMT-07:00	(GMT-07:00) Phoenix - Arizona

Table C-17 Time Zones (continued)

Time Zone (GMT +/– Hours)	Default Value
GMT-06:00	(GMT-06:00) Central Time (US & Canada)
GMT-06:00	(GMT-06:00) Mexico City
GMT-06:00	(GMT-06:00) Costa Rica, Managua, San Salvador
GMT-06:00	(GMT-06:00) Saskatchewan
GMT-05:00	(GMT-05:00) Bogota, Lima, Quito
GMT-05:00	(GMT-05:00) Eastern Time (US & Canada)
GMT-05:00	(GMT-05:00) Havana
GMT-05:00	(GMT-05:00) Indiana (US)
GMT-04:00	(GMT-04:00) Asuncion
GMT-04:00	(GMT-04:00) Caracas, La Paz, San Juan
GMT-04:00	(GMT-04:00) Atlantic Time (Canada), Halifax, Saint John, Charlottetown
GMT-04:00	(GMT-04:00) Santiago
GMT-04:00	(GMT-04:00) Thule (Qaanaaq)
GMT-03:30	(GMT-03:30) St. John's - Newfoundland
GMT-03:00	(GMT-03:00) Brasilia, Rio de Janeiro, Sao Paulo
GMT-03:00	(GMT-03:00) Buenos Aires, Georgetown
GMT-03:00	(GMT-03:00) Godthab (Nuuk) - Greenland
GMT-02:00	(GMT-02:00) Mid-Atlantic
GMT-01:00	(GMT-01:00) Azores, Scoresbysund
GMT-01:00	(GMT-01:00) Praia - Cape Verde
GMT 00:00	(GMT 00:00) Casablanca, Reykjavik, Monrovia
GMT	(GMT) Greenwich Mean Time
GMT 00:00	(GMT 00:00) Dublin, Edinburgh, London, Lisbon
GMT+01:00	(GMT+01:00) Amsterdam, Berlin, Rome, Stockholm, Paris
GMT+01:00	(GMT+01:00) Belgrade, Bratislava, Budapest, Ljubljana, Prague
GMT+01:00	(GMT+01:00) Brussels, Copenhagen, Madrid, Vienna
GMT+01:00	(GMT+01:00) Sarajevo, Skopje, Sofija, Vilnius, Warsaw, Zagreb
GMT+01:00	(GMT+01:00) West Central Africa, Algiers, Lagos, Luanda
GMT+01:00	(GMT+01:00) Windhoek (Namibia)
GMT+02:00	(GMT+02:00) Al Jizah, Alexandria, Cairo
GMT+02:00	(GMT+02:00) Amman
GMT+02:00	(GMT+02:00) Athens, Bucharest, Istanbul
GMT+02:00	(GMT+02:00) Beirut
GMT+02:00	(GMT+02:00) Cape Town, Harare, Johannesburg, Pretoria
GMT+02:00	(GMT+02:00) Jerusalem
GMT+02:00	(GMT+02:00) Kaliningrad, Minsk

Table C-17 Time Zones (continued)

Time Zone (GMT +/– Hours)	Default Value
GMT+03:00	(GMT+03:00) Aden, Antananarivo, Khartoum, Nairobi
GMT+03:00	(GMT+03:00) Baghdad
GMT+03:00	(GMT+03:00) Kuwait, Riyadh
GMT+03:00	(GMT+03:00) Moscow, St. Petersburg, Novgorod
GMT+03:30	(GMT+03:30) Tehran
GMT+04:00	(GMT+04:00) Abu Dhabi, Mauritius, Muscat
GMT+04:00	(GMT+04:00) Aqtau, T'bilisi
GMT+04:00	(GMT+04:00) Baku
GMT+04:00	(GMT+04:00) Yerevan, Samara
GMT+04:30	(GMT+04:30) Kabul
GMT+05:00	(GMT+05:00) Chelyabinsk, Prem, Yekaterinburg, Ufa
GMT+05:00	(GMT+05:00) Islamabad, Karachi, Tashkent
GMT+05:30	(GMT+05:30) Calcutta, Mumbai, New Delhi, Chennai
GMT+05:45	(GMT+05:45) Kathmandu
GMT+06:00	(GMT+06:00) Almaty
GMT+06:00	(GMT+06:00) Colombo, Dhaka, Astana
GMT+06:00	(GMT+06:00) Novosibirsk, Omsk
GMT+06:30	(GMT+06:30) Cocos, Rangoon
GMT+07:00	(GMT+07:00) Bangkok, Hanoi, Jakarta
GMT+07:00	(GMT+07:00) Krasnoyarsk, Norilsk, Novokuznetsk
GMT+08:00	(GMT+08:00) Irkutsk, Ulaan Bataar
GMT+08:00	(GMT+08:00) Beijing, Shanghai, Hong Kong, Urumqi
GMT+08:00	(GMT+08:00) Perth
GMT+08:00	(GMT+08:00) Singapore, Manila, Taipei, Kuala Lumpur
GMT+09:00	(GMT+09:00) Chita, Yakutsk
GMT+09:00	(GMT+09:00) Osaka, Sapporo, Tokyo
GMT+09:00	(GMT+09:00) Palau, Pyongyang, Seoul
GMT+09:30	(GMT+09:30) Adelaide, Broken Hill
GMT+09:30	(GMT+09:30) Darwin
GMT+10:00	(GMT+10:00) Brisbane, Port Moresby, Guam
GMT+10:00	(GMT+10:00) Canberra, Melbourne, Sydney
GMT+10:00	(GMT+10:00) Hobart
GMT+10:00	(GMT+10:00) Khabarovsk, Vladivostok
GMT+10:30	(GMT+10:30) Lord Howe Island
GMT+11:00	(GMT+11:00) Honiara, Magadan, Soloman Islands
GMT+11:00	(GMT+11:00) Noumea - New Caledonia

Table C-17 Time Zones (continued)

Time Zone (GMT +/– Hours)	Default Value
GMT+11:30	(GMT+11:30) Kingston - Norfolk Island
GMT+12:00	(GMT+12:00) Andyra, Kamchatka
GMT+12:00	(GMT+12:00) Auckland, Wellington
GMT+12:00	(GMT+12:00) Marshall Islands, Eniwetok
GMT+12:00	(GMT+12:00) Suva - Fiji
GMT+12:45	(GMT+12:45) Chatham Island
GMT+13:00	(GMT+13:00) Nuku'alofa - Tonga
GMT+13:00	(GMT+13:00) Rawaki, Phoenix Islands
GMT+14:00	(GMT+14:00) Line Islands, Kiritimati - Kiribati

C.4 CTC Default Settings

Table C-18 lists the CTC-level default settings for the Cisco ONS 15454 SDH. Cisco provides the following user-configurable defaults for CTC:

- Automatic Routing—Set circuit creation with the Route Automatically check box selected by default.
- Create TL1-like—Set whether to create only TL1-like circuits; that is, instruct the node to create only cross-connects, allowing the resulting circuits to be in an upgradable state.
- Local domain creation and viewing—Set whether domains that you create and view persist globally (all CTC sessions), or only locally (within the current CTC session).
- Network Map—Set the default network map (which country's map is displayed in CTC network view).

Table C-18 CTC Default Settings

Default Name	Default Value	Default Domain
CTC.circuits.AutoRoute	TRUE	TRUE, FALSE
CTC.circuits.CreateLikeTL1	FALSE	TRUE, FALSE
CTC.network.LocalDomainCreationAndViewing	FALSE	TRUE, FALSE
CTC.network.Map	United States	-none-, Germany, Japan, Netherlands, South Korea, United Kingdom, United States

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